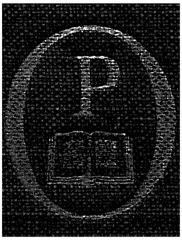


BY THE SAME AUTHOR

THE SUPER-ICARUS

HUMANISTIC LOGIC

THE ALCHEMY OF LIGHT AND COLOR

HUMANISM AND NEW WORLD IDEALS

PHILOSOPHY AND THE CONCEPTS OF MODERN SCIENCE

THE PROMISE OF
SCIENTIFIC HUMANISM

THE PROMISE OF SCIENTIFIC HUMANISM

TOWARD A UNIFICATION OF SCIENTIFIC, RELIGIOUS, SOCIAL AND ECONOMIC THOUGHT

By OLIVER L. REISER
ASSOCIATE PROFESSOR OF PHILOSOPHY
IN THE UNIVERSITY OF PITTSBURGH

NEW YORK
OSKAR PIEST
1940

PUBLISHED, 1940

PRINTED IN THE UNITED STATES OF AMERICA

TABLE OF CONTENTS

INTRODUCTION

In recent years we have been told to the point of weariness that the modern world is sick, afflicted with a mortal disease—a sickness unto death, as Kierkegaard describes it. Again and again it has been stated that the world we live in is growing more and more chaotic and must eventually end in disaster. Recent years have seen the world pass from one crisis to another, each succeeding crisis worse than its predecessor, until we are finally plunged into a new world war. It seems that the world we live in is geared too high for our sanity. Our ethical insights and social reforms hardly keep pace with our technological advances. We lag behind in solving our economic problems, while political tensions grow apace. All in all, as is clearly evident to all thinking persons, the contemporary world is in an excellent position to destroy itself.

The causes of the imminent collapse of our culture are not universally agreed upon. But this disagreement, of course, is only a phase of the cultural chaos which besets the modern world. Some attribute our troubles to the failure of the capitalistic system to overcome the inherent disruptive tendencies of the economic order. Others ascribe the conflict and confusion of the modern world to the political situation—the excessive nationalism of imperialistic states. Still others argue that it is because the modern world is irreligious, has "forgotten God," that we are headed for disaster. And so the diagnoses go.

It is interesting to note that many of the remedies proposed as cures for the ills of modern civilization rest on a return to what may be called intellectual primitivism. The modern Thomistic movement offers neo-Scholasticism as its cure for the aimlessness of modern society. The "crisis" theologians, Karl Barth and others, offer as our human salvation a return to supernaturalism and a sense of man's total inability and utter dependence on a higher power. Nicholas Berdyaev tells us that "the world is entering upon an epoch of Caesarism," and urges that the present state of things calls for a moral and spiritual revolution. In

like manner the Oxford movement asks us to prepare for a "moral rearmament." In all these cases, it will be noted, there is an obvious lack of faith in man's intelligence, in his ability to solve rationally the problems which man himself has created. Truly it may be said that there is here a "retreat from reason."

But to the student of human affairs who searches beneath symptoms and studies fundamental conditions another analysis suggests itself. This analysis leads to the conclusion that the troubles of the modern world are at bottom a result of the failure of philosophy. What the modern world needs is a new system of thought to replace the outmoded views which still linger on, reluctant to depart, and still confuse us by their very presence. As opposed to intellectual primitivism and cultural atavism, this new philosophy will maintain and assert its faith in the powers of human intelligence. Among modern groups the "scientific humanists" stand alone in telling us that we must go forward rather than backward, that we need not less science but more. These newer humanists may agree with our cultural recidivists and crisis religionists that the modern world needs badly a spiritual revolution, but they insist that it will have to be one inspired by a scientific understanding of nature; it must be guided by intelligence.

If our statement that the troubles of the modern world are a result of the failure of philosophy is true and if it is also true that the changes in practice cannot be consummated unless and until there are equally profound changes in theory, then it becomes evident that a fundamental revision of our philosophy is called for. But how shall such a new scientific world view, a vision which will provide an emotional outlet for mankind guided by intelligence, be attained? What new philosophical synthesis, or world religion based on science, can again inspire men in this despairing age? Let me here try to picture for you such a vision, and then you may judge whether it may unite and persuade men to look forward with a greater measure of hope toward a fearful and uncertain future. The view here presented has been in the process of development for many years. This broader undertaking, of which this present introductory sketch is but an anticipation, involves a twofold task: first, *to demonstrate that a radically new mode of human thought and orientation will be operative in the future, or must become so if mankind is to survive*, and second, *to indicate briefly what the world will appear to be when it is understood in terms of*

these new principles. It is difficult to outline in brief form the broad features of a view which is both comprehensive and yet technically intricate in its details, and yet I believe it is possible to summarize the main features of this proposed synthesis.

Our thesis, then, is this: If the modern world is to survive and continue its progress in a problematical future, its established culture-patterns, or models of belief and action, will have to be replaced by a new mode of orientation, a new culture-pattern. Viewed in this way, the disintegration of our contemporary civilization is only the inevitable concomitant of, and necessary prelude to, the fabrication of a new world culture. If we are to escape the impending disaster which hangs over our present disintegrating world, we must make our revision of the old, established patterns so far-reaching and so fundamental that our very modes of thinking about ourselves and our relations to each other and to the world at large will be overhauled. As we shall see later, this new mode of orientation—or semantic reaction, as we shall term it—may most properly be termed "global thinking." Its ultimate goal is the creation of what we shall term the "World Sensorium."

On other occasions I have argued that this revised way of thinking must be connected with the development of a non-Aristotelian logic and science. Our view is thoroughly evolutionary in its starting point and in its final outcome; it is based on the idea that the human brain and the mind of man are products of biological and social change. This in turn commits us to the somewhat paradoxical conclusion that our "understanding" of the processes of evolution which have culminated in the human mind is a function of that mind as it is at present constituted. Nevertheless, we affirm that: *the logic of evolution is but a special case of the evolution of logic.* We believe that our present habits of mind and so-called "laws of thought" are a product largely of social evolution; and we predict that in the process of trying to secure a better theory of evolution we shall foster, in our own mental outlook on nature, an evolution that will result in better explanations of both man's theory of nature and man's theory of himself.

Our general philosophical thesis is that human intellectual evolution may be subsumed under three main historical periods of development. These are: (1) the pre-Aristotelian period; (2) the Aristotelian period; and (3) the non-Aristotelian period. Primitive man functions on the first level of human mentality;

the human mind of today (of "civilized nations") is functioning on the second level of Aristotelian logic; and in the future the human mind will move on to the third level, the level of the non-Aristotelian mode of understanding. Later on we shall see that such a scheme of mental-social evolution is not altogether new, since James Mark Baldwin, Lucien Lévy-Bruhl, Alfred Korzybski, and Kurt Lewin have proposed somewhat similar analyses.

Now let us briefly consider the characteristics of each of the three levels of orientation.

(1) By the pre-Aristotelian mode of orientation I mean the level of primitive mentality as revealed by Lévy-Bruhl's studies. The primitive mind is "pre-logical" in the sense that it does not conform to the categories which the reasoning of classical European science has established. Lévy-Bruhl is convinced that primitive man does not observe the fundamental canon of Aristotelian logic, the law of contradiction, but follows an entirely different principle, which he designates by the term "participation." On the first level, the pre-Aristotelian or pre-logical mode of adjustment, the axiom is: "Everything is everything else." The "animistic" system (as we shall interpret it) is an expression of mystical participation in the sense that it does not distinguish between the self and the not-self. There are no sharp dichotomies in nature, because the Aristotelian "laws" of identity, contradiction and excluded middle are not respected.

(2) On the next level of mental evolution, that of Aristotelian logic and science, we get these sharp distinctions. Here the axiom is: "This is this," and "That is that," and "This is not that." The logic of Aristotle is a static logic; it is based on what I shall term the "fallacy of the absolute individuality of substance," the subject of predication.

(3) In proposing that the third stage of mental evolution is, or will be, the non-Aristotelian mode of thinking we mean that after the present age of specialization in science has passed, or has been supplemented by an era of co-ordination and synthesis of knowledge, we shall attain an understanding of the interconnectedness of things which will resemble primitive man's sense of "participation," in that here, on a higher level, we again realize the limitations of the classical laws of thought. On this coming third level we return to the idea that everything is everything else, except that this non-Aristotelian principle (unlike the pre-

logical principle of primitive mentality) will be based upon a deeper understanding of the unity and interrelatedness of nature.

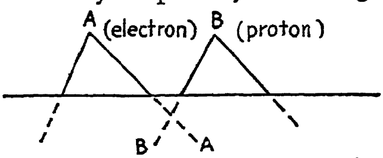
One significant feature of the science and philosophy that develops in connection with Aristotelian logic and science is the separation of intellect and feeling, reason and emotion. The present emphasis on the part of positivistic philosophy on the study of cognitive meanings and the exclusion of affective elements, allegedly because of the affinity of emotion with poetry, metaphysics, and religion, is only the latest consequence of this schism. The present impasse between sterile intellectualism and irrational emotionalism, running through the whole of modern life and separating religion and politics from the life of reason, is the unfortunate social consequence of this elementalistic psychology and cultural atomism. In an organismic (non-elementalistic) view of human nature this dualism and consequent mental conflict is resolved. You may, if you wish, call the present system a psycho-logic, or even a system of psychiatry, except that it must be remembered that behind it there is a philosophy of nature.

On the third level, the coming non-Aristotelian mode of orientation, humanity will attain a more profound insight into the unity of nature, and this will make possible a reunion of reason and emotion that will resemble primitive man's fusion with nature in mystical participation. On this level the present "laws of thought" will appear as special cases of a broader understanding. The old idea of absolute truth, devised to fit a world of changeless and perfect forms, will then be replaced by a multiple- or *n*-valued logic of probability in which the true-false dichotomy will appear as a limiting case. Like primitive man the new humanity will again be non-Aristotelian in its outlook, not however because we completely disregard the present canons of logic and science, but because we discern an underlying continuum of nature in which "individuality" becomes relative to the wholeness of which it is a part. The fundamental fallacy of Aristotelian logic, the postulate of the absolute individuality of the subject, is a product of the social evolution which exaggerates the cultural atomism of the human self. The statement that "rugged individualism" in economics is a reflection of the metaphysical individuality of Aristotelian logic, and that conversely this is a cultural manifestation of a Greek culture which was outgrowing its earlier level of customary morality, contains more truth than poetry. But so

far as I am aware, only Brouwer has recognized the social character or background of the "laws of thought."

The most fundamental and widespread postulate of all classical western European thought of the last twenty-five hundred years may be called the atomistic or elementalistic postulate. It culminated in the doctrine that we can isolate any system, that this system is independent of its environment, that we can investigate such self-identical systems and determine to any desired degree of accuracy the state and properties of any such particle or system of particles. This is our interpretation of the notion of "nature at an instant."

This atomistic scheme was carried over into biology, and indeed appears in even so recent and emancipated a work as J. H. Woodger's "axiomatic method." That this postulate is false in physics was shown by Heisenberg in his famous principle of indeterminacy. That it is false in biology is even more obvious. The new situation may be portrayed in diagrammatic form as follows:



Level of perceived universe. "Identity" due to abstraction from environment.

Sub-universe of wave mechanics. Here "identity" dissolves into second-order continuities.

Wave system of the atom—or even the entire universe, as Eddington supposes.

Of course, if we change our "units"—substitute human individuals for electrons—we must also change our "base," and in this case it becomes the social milieu, or culture-pattern as a whole.

Our theory, accordingly, is not only a physical theory; it applies to all levels of nature and is completely "organismic" and "relativistic." Thus we hold that just as a protein molecule as a member of a society of molecules may retain some (minimal) residuum of past environmental influences and to this extent is an historical entity (or exhibits what the physicist terms *hysteresis*), so each man biologically is a kind of local eddy or whirlpool in the stream of life coming down from the remote past, and emerges momentarily on the social level in the human personality as now constituted. And culturally each person as an individual entity is a focus of the social "forces" which make up the stream of human history. In its broadest terms (to look ahead for a moment) this may mean that the entire human race really appears as an embryonic being developing here on earth. Man-

kind, it may be supposed, is the central nervous system, the developing neuroblast, of the system of animate nature; and races and nations then have their being only as parts of the evolving superorganism.

If at this point it is appropriate to suggest a name for this new way of looking at nature, the term "Planetism" might be recommended. The thing that impresses one about the cultural change in our interests and in our thinking is the extent to which we, largely as a result of the influence of the radio, are becoming earth-conscious. At one time our interest is in Ethiopia, and we study the maps and visualize the progress of a military campaign over its terrain. Then our interest shifts to Spain, or to the North Pole, or to China. We jump from a study of the religion of Japan to talk of the influence of a red-headed mistress on the politicians of Rumania. What happens in Palestine today may become more important to us than what happened in Bethlehem twenty centuries ago.

History not only unites and condenses space; it is also time-binding in its effects. The earth moves on to its new destiny, and man discovers more and more how his fate is linked to that of the planet which is his nursery, his home, and his grave. Among contemporary scientists this fact, that man's life here on earth is but a part of a wider pattern of events, has been clearly seen by Paul B. Sears. His earlier book, *Deserts on the March*, and his more recent work, *This Is Our World*, may become minor classics in the literature of planetism. Thus we are learning to look upon the earth and our relation to it in terms of organismic co-ordinations.

As previously indicated, another designation we may employ to cover this coming outlook on nature is the term "global thinking." Planetism as a form of consciousness means that *we are becoming global in our thinking*. This is part of the emerging non-Aristotelian mentality which sees and avoids the fallacy of the old law of identity (absolute individuality).

We seriously propose that the old Aristotelian-Euclidian-Newtonian world picture is based on the idea that the world is flat. The objection that, after all, Newton (and some of the ancient Greeks for that matter) realized that the world is round, that indeed Newton brought the Copernican cosmology to its perfection, does not refute our statement. Newton's world view is

based upon the supposed uniqueness of Euclidian geometry, and his thinking is fundamentally planal rather than global. Planal thinking is based on the axiom that everything is self-identical, absolute, and independent. The Newtonian-Laplacian particle-picture is additive and elementalistic. It is for this reason that classical physics treats "time," "space," "matter," etc., as absolutes. Global thinking, being organismic, regards these and other atomistic notions as artifacts obtained by abstraction from a space-time-matter unity. In the universe of modern relativity theory we escape the limitations of the older view: the lines of the universe (for instance, the path of a ray of light) are not flat or "straight" in Euclid's sense; they are curvilinear. Mass is not an absolute; electromagnetic mass ("substance") is relative. Not even the *form* of things—which Aristotle in his geocentric-anthropocentric view could treat as absolute because he selected an absolute frame of reference—not even form, we say, is absolute. Time and space cannot be split in the elementalistic fashion which Aristotelian logic and science demand. Form can be absolute for the Aristotelians because Aristotle's metaphysics is based on a privileged observer who splits space and time. But now relativity physics has destroyed all this. In relativity theory, action (energy integrated through time) represents the curvature of the space-time world. If, therefore, planetism is global thinking on a small scale, the expanding universe theory of Lemaître and Einstein is simply global thinking on a large scale.

In the following chapters we present instances of the non-Aristotelian outlook. These examples are taken from physics, biology, and social science. In order that the reader may follow the argument more easily, let us here merely epitomize the development.

In physics we rest the case for a non-elementalistic and organismic theory upon three examples: (1) the relativity of substance as an integral part of the electrodynamic theory of matter; (2) the notion suggested by Korzybski concerning the non-additive character of the velocity of light; and (3) George H. Mead's conception of emergence as applied to physics. In the case of Professor Mead's view we start from the basic proposition that temporal passage is itself a kind of relativity, while "sociality"—an important category in Mead's thinking—is the capacity for being several things at once, which is possible because the novel event

is both in the old order and the new order which its advent heralds. In this manner Dr. Mead arrives at an original interpretation of physical relativity. For him the increase in mass which accompanies the increase in velocity of a physical system is due to the fact that the "emergent" motion changes the physical character of its object (the mass). From this Mead goes on to argue that just as emergent velocities change the character of masses, so in a similar way life as an emergent changes the character of its world. In our own interpretation we proceed along somewhat similar lines to the conclusion that the "wave" character by means of which the "individuality" of a particle dissolves into the "mist" of the indeterminate (for example, of a "probability wave") is an expression of the "sociality" of the electron. Thus our rejection of the absoluteness of substance in physics in favor of the notion of relativity and the emergent evolution of behavior-stuffs is in keeping with our organismic logic.

With this general non-Aristotelian view as a background (non-Aristotelian because Aristotelian logic, metaphysics, and science permit nothing new, no real evolution, and no genuine dialectic in nature), one can proceed to rewrite the entire domain of knowledge by applying such organismic principles of complementarity and relativity. In the biological field we put these ideas to work in our speculations concerning the origin of life in terms of a sun-planet-organism hookup. Here the sun's radiation and the earth's gravitational and electromagnetic fields enter into the kind of energy-couple which is essential to vital systems. This in turn is the background for the subsequent evolutionary process we designate by the term "cosmecology." The manner in which cosmic rays might periodically provide the kicks which produce evolutionary spurts is suggested. The dynamics of our own solar system is certainly involved here, but with a leap of the imagination we arrive at the further possibility that the rotation of our whole Milky Way may enter into the picture.

This then brings us to the advent of the human species, and our non-elementalistic theory of evolution leads us first to the idea that since the velocity constants of the chemical reactions in the brain may in turn be a function of the earth's gravitational field (constant), a continuation of this same line of speculation brings us to the supposition that our human time sense may be a function of the rate of expansion of our "cosmic bubble."

The final application of the non-Aristotelian conception of evolution leads us to consider man as an evolving creature. We think of humanity not in static terms as a finished product, but as an inflection point in a curve of evolutionary progress. What additional psychic faculties still remain to be developed we shall venture to surmise later on. Here we merely reiterate that eventually, through further biological and emergent social evolution, humanity will acquire a new mode of orientation and even different habits of thought. Thus we are led to reaffirm that science is calling for and helping to create a new mentality.

In concluding these introductory remarks it remains to be pointed out that some of the material of this volume previously appeared in the form of journal articles, for the most part in *The Monist* and *The New Humanist*. Additional acknowledgments are made in the proper places in the body of the text. Some of the material of Chapters I and XVII was first presented by the author in the Second Annual Lectures of the Los Angeles Society for General Semantics in April, 1940. The quotations on Humanism by John Dewey appearing at the heads of several chapters are taken from Professor Dewey's review, in *The New Humanist* of September, 1935, of the author's previous work.

PART I

LOGIC AND NATURE

CHAPTER ONE

THE MEANING OF HISTORY

When two or three are gathered together in the spirit of the future it begins to dominate them, to break down their isolation, to confer powers, and finally to deliver them into a new unity—as real as their former separation—the progressive development of individualism into a larger consciousness is the solution and destiny of the future

—Gerald Heard

I. The Panorama of Social Evolution

For many years anthropologists, historians, and cultural sociologists have been accumulating information about the origin and evolution of humanity here on earth. Since the dawn of his existence in some remote era of the past, man has tried to visualize his career and high enterprises on the surface of his planetary abode. Therefore, we have myths, runes, and records attempting to reconstruct man's history, migrations, social experiments, and cultural aspirations. Folklore, fairy tales, and scientific history all satisfy the same universal curiosity in mankind.

Aside from the sheer desire to know—an intellectual interest in knowledge for its own sake—there is also a practical motive behind the modern intensive research of the historians and the social scientists. The gropings into the cultural hinterlands of humanity are in part inspired by a profound faith that the adventure of human history is not meaningless. Indeed, the quest is more than this: it expresses a desperate hope that the attainment of a continuous and universal history of humanity will enable man to save himself and his civilization from chaos and disaster. Thus, in addition to the universal esthetic impulse to create a unified picture of humanity's far-flung drama, there is a serious purpose, directly related to the conviction that if we can understand what man has been and what he now is, we may predict, or possibly even determine by conscious control, what man will be.

This is the program and the hope. And what of the results of

this stupendous undertaking? The difficulties of the project are simply overwhelming. The variety of theories of human history which have been and are brought to bear in interpreting the past—and all writing of history is guided by some theory of history—illustrates the difficulty of the task.

The facts of history constitute a heap of glittering mosaics, awaiting the touch of the artist's hand to be assembled into some meaningful pattern of events. But no craftsman of sufficient power seems to be able to fit these isolated pieces of the puzzle into the completed picture. Even a more limited area of the crazy quilt is difficult to decipher. For example, what does America mean? How does it fit into world history? What is its mission, if any? In reply we may well surmise that the writer who can grasp the wholeness of America does not exist. Indeed, this has already been pointed out by someone. And when, on a much larger scale, J. H. Breasted raised the question of whether anyone could ever form a vision equal to the whole sweep of history, he was merely testifying to the difficulty and the fascination of the problem.

But in spite of the fact that no man has been able to encompass all the itemized information, let alone synthesize the facts of history into a picture, there still persists the belief that the entire world situation today is an exfoliation of some law of natural growth which, could we but grasp it, would not only illuminate the human drama in its evolutionary aspect, but also enable man to master the process and mold its course a little closer to the heart's desire. Thus, while one writer asks, "What fiction-drama ever equaled Hitler?" another will opine that Hitlers are as natural as dustbowls, floods, and the like. But if so, what is the law of social evolution that predicts the advent of dictators in the evolution of capitalistic civilizations? And what will be the aftermath?

We repeat: the problem of the modern world is to bring order out of threatening social chaos. The task is also to find an intellectual unity to provide an ideological underpinning for a new cultural synthesis. These two, it is clear, must go together; the one cannot be attained without the other. Surely, we must stress the need of mental reorientation as a prelude to successful large-scale political and economic readjustments. If the reader has doubts about this, consider the fact that nationalism today is not

only political but cultural too. "Fascism," "communism," and "capitalism" are social programs, and the science and philosophy that flourish under their guidance and control are adapted to their respective ideologies. In a similar way, the new cultural synthesis we have referred to is sorely needed if the world is to be integrated into a larger unity. Political, economic, and racial barriers are to a considerable degree psychological barriers, and these can be overcome or subordinated only by something approaching a cultural realization of the unity of humanity.

The kind of unity we have in mind was attained by the ancient Greeks in their city-states. It was also exemplified by the medieval synthesis presented by scholasticism. In the first case it was symbolized by the beautiful simplicity of a Greek temple, and in the second case by the harmonious aspiration of a Gothic cathedral. But modern life has been unable to combine effectively the architectural motifs of the two, and in a similar way the ideologies of modern thought are no less in conflict.

We have referred to the unity of culture in the Middle Ages. In the civilization of the medieval world the scholastic thinkers had a vision of a *scientia scientarum*, a science of sciences. Unfortunately, from the viewpoint of a modern philosopher, the medieval thinkers looked upon theology as the "queen of the sciences." At the beginning of the modern era this reigning queen was deposed, and now there are few so humble as to do her reverence. Nonetheless, the notion of a science of sciences still presents us with a worthy ideal. The modern world needs badly the kind of synthesis of knowledge that this term symbolizes. One of the necessary objectives of modern culture is a new *scientific humanism*, which will embody and express just such a coordination. This new scientific synthesis will be based upon a specific recognition of the unity of nature and human nature, and it will insist that each "special" science is man's way of partitioning off the universe into sets of abstractions within the larger context of the world-order. This new scientific humanism, including within its scope what one writer terms "cosmecology," holds that while the old maxim, "divide and conquer," may in the past have represented a pragmatically useful strategy in intellectual progress, it now needs to be supplemented by a principle of "complementarity." Accordingly, the new maxim will be: "unify and understand."

It is not necessary at this point to dwell on the theme of the unfortunate consequences of specialization in modern culture. Recognizing that specialization has its values, it is sufficient here to note that the harmful effect of the specialization of knowledge in the sciences is seen in the intellectual isolation of the sociologists, psychologists, economists, etc., who, working in separate fields, are unacquainted with the attainments of fellow workers in adjacent fields. Another illustration of these evil effects is found in the futility of many courses in the curricula of our institutions of higher learning. Chaos and futility in education are due in part at least to the fact that man's interests, and his culture, are split up, so that while logic studies man as a "thinking" being, psychology studies man as an "emotional" and an "instinctive" creature, psychiatry studies him as an "abnormal" organism, biology studies him as a physiological machine—and so on. The truth is that organs, tissues, reflexes, ideas, emotions, complexes, and the rest are all abstractions. Ideas are always emotionally conditioned, and emotions in man are always ideationally directed. The separation of mind and body is artificial. The application of a test of "logical consistency" to hundreds of university students has convinced the writer that the lack of intellectual integration we have found is connected with the departmentalization of knowledge—educational atomism, we may call it—and it is this which is behind the ineffectiveness of the educative process as it now impinges upon the student.[1]

It is with this background that we now approach the specific question of how we may secure the new unity and cultural synthesis that society must attain if it is to survive.

In answering this question we begin with the thesis that the trouble in the past has been, not that the human historical sciences have too much information and detailed fact to make such organization feasible, but that hitherto there hasn't been enough of such information: not too much history—too great a span of time to cover in our intellectual purview—but not enough. We must return to this in a moment, but before doing so let us pause to examine the fallacy that seems to accompany the failure to recognize one important point.

The fallacy underlying research in what we may term cultural

[1] A presentation of this test, with a discussion of the results of its use, will be found in the author's volume, *Humanistic Logic*, 1930, pp. 186–200.

paleontology and the writing of history is the idea that the past is past. There is a very general belief that the past is irrevocable, that history cannot be changed Now, it is doubtless true that the past is past; but certainly this does not prove that the past is unalterable. To argue that this is so is to reason in materialistic rather than in organismic terms. In the cultural interpretation of human history the past is what it is because of its influence on the present. And if we change the present, we have in a sense altered the past. That is to say, the "present" of any era, individual or social, is an inflection point in the curve of life-history. If, in the sphere of individual history, the meaning of an experience suddenly breaks upon us, that original event is no longer what it was. Experiences and events are what they function as, and if we change the effects and meanings, these original phenomena are no longer what they were, at least to us. There is here a real alchemy in events that is grounded in time's living progress.

Applied to the writing of history, this means that there is always room for a reinterpretation of the past in the light of an expanding present, particularly as that present modifies our notions of the past. History is the expression of an aspiration and a groping. No man or age fully realizes what it is about. Men and movements are focal points where the broader social vectors and cultural trends, like tangents to the curve, touch the developing present. It is for this reason that histories of human culture need to be rewritten from time to time. Today we can see how the Greek philosophers were at times rationalizing their own cultural backgrounds, although they themselves, being inextricably interwoven with that background, were not conscious of the "socially conditioned premises" of their own thinking. Time is the great emancipator; contrast is the only liberator from provincialism. If, therefore, the revivification of the past is sufficiently realistic, history becomes a growing thing. And this, applied to our own problem, means that we can and must find in man's intellectual evolution the continuity of meaning that is inherent in every organic process.

In our own theory of the approaching cultural synthesis we present as the groundwork of such a system the thesis that in its broadest terms human history is the expression of three types, or levels, of orientation to nature. This could not be evident to the earlier interpreters of human mental and social development be-

cause, as we have already pointed out, they did not have a sufficiently broad, extensive, and detailed knowledge of the past *in its implications for the present* to see the meaning residing in the social process as it culminates in the developing present. Only now is the third stage in this organismic process becoming clear, and it is this that makes articulate the two preceding eras.

From these comments it is clear that although the present view is based on the idea that our contemporary civilization is disintegrating, this view is not pessimistic in its ultimate outcome. On the contrary, the creation of the new culture, which is to replace our decaying old civilization, calls for the fabrication of a new mentality. In order to achieve the transformation of our old civilization into the new world order there must be a change in our attitudes toward one another and toward the universe in which we live. This new mentality I shall call the non-Aristotelian mentality, and the coming evaluations will involve the creation of a non-Aristotelian semantics.

Before, however, we launch into an exposition of this new orientation, let us indicate briefly how we propose to justify the statement that our modern civilization is indeed doomed to destruction. We begin with some general comments about the nature of "culture," as the term is now used by the sociologists.

II. The Meaning of Culture-Patterns

A culture is the sum-total of beliefs, practices, traditions, and patterns of behavior that give coherence and continuity to any self-perpetuating human society. As E. B. Tylor has pointed out, the term culture refers to the tool-using, institution-making, and value-realizing activities of human beings. A culture-pattern is a way of thinking, feeling, and acting common to a group. These patterns of ideas and behavior are passed on from one generation to the next through the instruments of social heredity. A culture is not instinctive; it is acquired, or learned. *No sub-human animals have cultures.* Only human groups build cultures and pass them on to new generations. The things that hold a civilization together and give it whatever unity it possesses are these culture-patterns, and when these culture-patterns begin to disintegrate, the civilization through which they express themselves is also headed for the rocks.

For at least twenty-five hundred years Occidental civilization—

primarily western European civilization and the derived American culture—has held together fairly well. Bertrand Russell has said that modern civilization is a product of three factors: the Bible, the Greeks, and machinery. (The Bible gave us our religion, the Hebrew-Christian tradition; the Greeks gave us the beginnings of science and political rationalism; and the Industrial Revolution gave us the factory, quantity production, large cities, and many contemporary social problems.) But Russell does not trace our civilization back as far as he might. If it is true that the Egyptians gave us primitive mathematics, the Chaldeans left us astronomy, and the Hebrews derived many of their religious ideas from the Babylonians and the Egyptians, then the roots of our Western civilization go deeper than the old Greeks.[2] If the origins of Western culture go back beyond the Graeco-Roman world, then we may say that our Occidental civilization is much older than the twenty-five centuries previously suggested; perhaps five thousand years is a good guess.

If our civilization, old as it is, is now beginning to disintegrate, as seems to be the case, this means that we are losing our dominant culture-patterns as an integrating force in society. To see this requires no prolonged research on the point. All one needs to do is to look around and to observe what is happening. The evidence that our civilization is "going to pot" is everywhere present. It is a fearful experience to peer into the future, but whatever world we foresee, it must surely be something different from our present order.

One essential ingredient of the culture-patterns that held our civilization together and gave it whatever unity it possessed was a common semantics: that is, a universal language, a common science, and a common set of values. Looked at in its broadest features, western European civilization of the last twenty-five centuries embodied and expressed a common orientation. The logic of this civilization was Aristotelian, and this logic provided the basis for all our science, philosophy, and religion. The

[2] In his book *Human History*, G. Elliot Smith argues that the original center of invention and culture was Egypt, and that by the process of the *diffusion of culture* it was then passed on to Europe, Asia, and America. Specifically, with respect to the indebtedness of the Hebrews to Egyptian culture, see the volume by James H. Breasted on *The Dawn of Conscience*. A similar theory of the Egyptian origin of Judaism is presented by Freud in his last volume, *Moses and Monotheism*. The present writer's views on this matter are presented in the volume *Philosophy and the Concepts of Modern Science*, 1935, Ch. IX.

languages that gave unity to our culture heritage and made communication and transmission of common ideas possible were primarily the Latin and Greek languages—or, more generally, the Indo-European family of languages. These languages, plus the study of logic and mathematics, and backed up by an accepted set of values, constituted the backbone of the curricula of our institutions of higher learning. The classical-cultural theory of education stated that educated people must study Latin, Greek, and mathematics. These intellectuals, those who to a large extent ran our societies, told the rest of the people what was right, and true, and respectable in morals, politics, science, and religion.

Now there is a breakdown of the old logic and the old language as techniques for securing social understanding and co-operation. Undoubtedly "economic" and "political" factors also have much to do with the processes of disintegration that are going on around us, but the misuse of language, or the inadequacy of the old language and semantics to deal with the problems of a new world situation, is an important cause of our social confusion. The "tyranny of words," to use Stuart Chase's phrase, is part of the new Tower of Babel that we have erected for ourselves. If this indictment is correct, the remedy may well be found in the development of a new type of understanding and technique of communication—a new logic and a new language. This, of course, is strong medicine, and one could only wish that the illness of society were not so serious as to require such heroic remedies. My own hope is that the task of reconstruction is not that difficult, but it is probable that few of us appreciate the magnitude of the problems we now face.

We have referred to a new mentality and a new type of orientation or semantic reaction. This, of course, implies that the human organism is still in process of evolution. It is a curious thing that although psychologists of the twentieth century pay lip service to Charles Darwin and his doctrine of biological evolution, they have never really taken the idea of evolution seriously, in the sense that they realize that the human type is still "on its way" and that evolution has not yet completed its work. One may seriously argue that we are growing more "conscious," in that we possess a greater "awareness" of our environment; we react to a wider range of stimuli in space and time, and this perhaps is leading

us to an increased intensity of inner life. We are now facing the necessity of handling a greater variety and number of stimuli—more variables—in our orientations. This, one would like to believe, will in time help us to create the new mentality, based on a non-Aristotelian semantics, exhibiting a deeper sense of the interconnectedness of nature's processes. It is my hope that since man can in a measure determine his own fate, or create his own future, he will in time learn to develop intellects with a deeper insight into the unity of the cosmos and a greater mastery of the problems of our physical and human social environments.

Fortunately, I am able to say that this idea that the human mind is still in process of development is not in any considerable measure original with me. The idea that our understanding is evolving, that our semantic reactions are still in process, has been presented in different forms by several different investigators. Among those who have played with this theme in one form or another are James Mark Baldwin, Lucien Lévy-Bruhl, Alfred Korzybski, Kurt Lewin, and possibly others. So far as I know, the first person to suppose that the evolution of thinking passed through three stages was the German philosopher Hegel, who gave us the famous dialectical movement which the Marxians have more recently refurbished. Next came J. M. Baldwin, whose three stages were:

The Pre-logical Stage
The Logical Stage
The Hyper-logical Stage

The next investigator to study our orientations (or semantic reactions, as he prefers to call them), and arrange them according to a threefold development, was Count Alfred Korzybski. His statement as given in *Science and Sanity: An Introduction to Non-Aristotelian Systems and General Semantics* (1933, p. 194) is this:

We may distinguish three periods of human development as characterized by their standards of evaluation:

(1) The prehuman and primitive period of literal, general, and unrestricted identification. The semantics of this period could be formulated roughly as "everything is everything else," which might be called one-valued semantics.

(2) The infantile, or *A* period of partial or restricted identification, allowing symmetrical relations, to the exclusion of asymmetrical rela-

tions. Its semantics involve, among others, the "law of identity"—everything is identical with itself," its two-valued character being expressed by the postulate "A is B or not B."

(3) The adult, or $\bar{A}$, or scientific period based on the complete elimination of identification, by means of asymmetrical and other relations, which establish *structure* as the foundation of all "knowledge." Its semantics follow the ∞-valued semantics of probability and recognize "equality," "equivalence," but no "identity."

My own analysis of the evolution of orientations or evaluations is likewise threefold in its division.[3] It has points in common with all the schemes previously mentioned, though I believe it comes closest to that presented by Korzybski.

This method of classifying and naming the three periods of semantics through which the human race passes in its evolutionary career yields the following types of mentality (as I shall term them):

(1) The Pre-Aristotelian Mentality and Orientation.

(2) The Aristotelian Mentality and Orientation.

(3) The Non-Aristotelian Mentality and Orientation.

The first is the level of primitive man, whose mentality is "pre-logical," to use Lévy-Bruhl's term. The second level is that of Occidental civilization since the time of the ancient Greeks. The third level, the non-Aristotelian mentality, is the coming level which ultimately (we hope) will become universal. But before going into that matter, let us restate the three modes of orientation in terms of the "axioms" on which they are based.

On the first level, the pre-Aristotelian mode of adjustment of primitive man, the axiom, is "Everything is everything else," to use Korzybski's terminology. The "animistic" system does not distinguish between the self and the not-self. There are no sharp dichotomies in nature, because the Aristotelian "laws" of identity, contradiction, and excluded middle are not observed. On the next, the second level of mental-social evolution, that of Aristotelian logic and science, we get these sharp dichotomies. Here the axioms are "This is this," and "That is that," and "This is not that." But on the third level we return to the idea that "everything is everything else" (within limits), though this

[3] See p. 13.

non-Aristotelian principle is now based on a better understanding than primitive man possessed of the unity and interrelatedness of nature.

TABLE ONE

Levels of Human Orientation

Period	Characteristics
I. *Pre-Aristotelian or Primitive Orientation* (Began perhaps 500,000 years ago and terminated with early civilization of 5,000 years ago)	One-valued semantics. Pre-logical period. Emotional elements predominate. Sub-vocal (gesture) communication. Old brain activity (thalamic). Assumption is: "Everything is everything else." Poor differentiations. "Mystical participation." No "laws of thought"; no categories, such as "space," "time," "matter," and "causality." No fallacy of elementalism. Group consciousness strong—no individualism (or "egoism").
II. *Aristotelian Orientation* (This is the semantics of western European and American culture, about 3,000 years old and still used.)	Two-valued semantics. Period of restricted identification. Emphasizes "reason" and excludes "emotion" from science. New-brain activity. Highly verbal and cortical. Abstract symbolism enters. "Law of identity" appears. Scientific categories, such as "space," "time," "matter," "causality" are developed. Fallacy of elementalism appears. Science becomes A-E-N. Axiom is: "This is this, that is that, this is not that." Social individualism (egoism) appears.
III. *Non-Aristotelian Orientation* (For a coming or new civilization—yet to appear (?))	Multi-valued semantics. No fallacy of identification. Results in a psycho-logic, a fusion of "reason" and "emotion." Co-operation between cortex and thalamus ("head and heart"). We recover some of primitive man's sense of the "unity of nature." Co-ordination and synthesis of knowledge. Fallacy of elementalism is overcome. No splitting verbally of things that are not split factually. Space-time universe. Science is $\bar{A}$-$\bar{E}$-$\bar{N}$. Social egoism is subordinated. No racial-religious identifications. A Scientific Humanism appears. Global Planning. A field-plenum dynamics.

With this general statement as a basis, we now proceed to examine each of the foregoing levels in order and in more detail. The discussion of the first two levels is a description of what has

been; the discussion of the third level involves a prediction of what may be. It is not a matter of "looking at the record" so much as it is an attempt to see into the future and to prophesy coming events

III. Primitive Mentality

Turning now to the first level of human orientation or adjustment, we find that primitive man had what Lévy-Bruhl described as a pre-logical mentality. On this level the human being "knows" and interprets the world through personal feelings and experiences, largely emotional, which are projected upon the canvas of what a later stage of science calls the "external world," or the "environment." This level is largely thalamic, as opposed to the next level, which is largely cortical. That is, ancient man used the "old" brain, whereas early European science developed out of the activity of the "new" brain. On the primitive level there are poor differentiations, and such "thinking" as primitive man did was on a sub-verbal level On this level there are strong visualizations, or what is technically called "eidetic imagery"—still found in children today. This imagery (frequently involving a fusion of what we call the "subjective" and the "objective") has a pronounced feeling-tone, due to its connection with the optic thalamus and the old-brain (emotional) background. It is the presence of this thalamic background which leads to a projection of subjective visualizations upon the canvas of the external world. While primitive man has vivid imagery, he does not have *abstract symbolism*, precisely because his consciousness is concrete rather than abstract.

We have already stated that in our interpretation we are in a considerable measure following the lead of Professor Lévy-Bruhl, whom Korzybski also seems to follow at some points. For over a quarter of a century Lévy-Bruhl has expounded the thesis that primitive mentality is "pre-logical," in the sense that it does not conform to the categories which the scientific reasoning of a later culture established—such categories as "space," "time," and "causality," as these appear on the second level of Aristotelian mentality. His anthropological investigations have shown, he believes, that "primitives" do not observe the fundamental canon of Aristotelian logic, the law of contradiction, but follow an

entirely different principle, which Lévy-Bruhl designates by the term "participation." In our own interpretation we would say that the system of primitive magic known to the anthropologists by the term "animism," resting as they say on a "personification" of the "forces" of nature, is a result of a feeling of a union of man and nature Here there is what Lévy-Bruhl calls "mystical participation," in the sense that man and nature are felt to be one, together, and not separated as they are in later science, philosophy, and religion.

The implications of Lévy-Bruhl's challenging view are far-reaching for social science not only because, if correct, they invalidate much accepted anthropology, but also because such implications lead us to the conclusion that the "laws" of our thinking and explanation (semantics) are a product of biological and social evolution. This conclusion in turn suggests to logic and psychology (or a new psycho-logic) the possibility of still further change along the lines of mental development for mankind. In this connection we propose that the third stage in this evolution is, or will be, the non-Aristotelian mode of orientation. We have already intimated that this third type of semantics seems to resemble in some respects a return to the first type of orientation, in that this new level of orientation will be associated with its own unity of man and nature. I mean by this that after the present stage of specialization in science has passed, or has been supplemented by an era of co-ordination and synthesis of knowledge, we may again attain an understanding of the interconnectedness of things (events) which resembles primitive man's sense of "participation," at least to the extent that here, on a higher level, we again realize the limitations of the classical Aristotelian "laws" of thought.

And now let us pass on to consider in detail this second level, where the Aristotelian principles regulate human semantics through their two-valued judgments.

IV. The Aristotelian Mentality

On this level of mental-social evolution, we find the sharp distinctions which are absent in primitive orientations. This is the logic which was taken over by subsequent science, so that for over two thousand years western European thought paid tribute to the forms established by Aristotle. The Aristotelian mentality thinks

in terms of clear-cut categories. It is highly verbal and articulate, and the linguistic forms in terms of which thought expresses itself and communicates its results are translatable from one special language to another of the Indo-European family of languages. The grammatical forms (nouns, verbs, adjectives, etc.) are sufficiently uniform to provide a common base for European civilization, a civilization that in spite of ups and downs has endured for over twenty-five centuries. This verbal-conceptual level of orientation is a level of symbol manipulation. It is highly cortical, involving the new brain primarily. Sharp dichotomies, based on the Aristotelian canons of thought, lead to classifications (for instance, the "Tree of Porphyry") and divisions. This power to abstract and think in terms of ideal categories and terms (intensional orientations, Korzybski calls them) is based on the Aristotelian logic of classes (the subject-predicate proposition), the ultimate basis of which is the "law of identity" ("*A is A*") and the "law of excluded middle" ("A is either B or non-B"). One important consequence of this subject-predicate logic, or logic of classes, is what Korzybski calls "elementalism." This in turn leads to the verbal splitting of things which in nature are joined together; for example, the splitting of reason and emotion, body and soul, space and time, and other supposedly independent (elementalistic-atomistic) entities. I shall return to the unfortunate consequences of these schisms later on.

In all probability it is to the Greeks, and primarily to the Aristotelians, that we must attribute the formulation and extension of the most fundamental and widespread postulate of all classical European thought of the last twenty-odd centuries. This postulate may be called the "elementalistic" or "atomistic" postulate, or the "postulate of the elementary particle." The first beginnings of this idea are to be found in the early nature philosophers who preceded Aristotle—principally the Greek atomists or materialists as they are called (Leucippus and Democritus).

The properties attributed by the Greek materialists to their ultimate (elementary) particles were these:

(1) These particles are eternal, indivisible, and indestructible.

(2) The structure of all particles is definite, uniform, and the same for all particles of the same sort, though there are admitted to be different kinds of "chemical substances."

(3) The structure of particles is independent of the external conditions (the "environment"), and is independent of the past history of the particle.

When the atoms, the elementary particles, of the Greeks turned out to be complex (we all now know that atoms disintegrate, and by bombardments can be broken up), these same properties were then transferred to the new particles which replaced the atoms as the ultimate building bricks of the universe. Electrons and protons, particles of negative and positive electricity, thus acquired the properties formerly supposed to be possessed by the atoms.

Even though Aristotle himself did not subscribe to the atomistic materialism of his predecessors, he did not escape the influence of their concept of the elementary particle. In Aristotle's own thinking the dualism of "substance" and its "properties," the "thing" and its "behavior," reappears. The Aristotelian fallacy of the "absoluteness of substance," or the fallacy of the absolute individuality and self-identity of the subject of predication, is connected with Aristotle's elementalistic thinking; his logic of classes is a logic of substances and their attributes (properties and behavior), and his intensional (idealized-verbal) categories serve the same purpose. Needless to say, a modern organismic or non-elementalistic orientation rejects this notion of the "elementary particle," and substitutes for the Aristotelian logic of classes and substances a logic of relations where the *relativity of substance* can be provided for.

The supreme culmination of the Greek doctrine and influence appears in the doctrine that *we can isolate any system—that is, that this system is independent of its environment—and that in science we can investigate such self-identical systems and determine to any desired degree of accuracy the "state" and "properties" of any particle or system of particles.* Parenthetically it may be noted that even the concept of the soul (or mind) was affected by this notion of the elementary particle. The soul, by analogy with ultimate material substance, was defined to be simple, indivisible, eternal and perfect, unaffected in its essential nature by the influences from the environment and the accidents of history. Thus later philosophers and theologians spoke of the soul as a "substance" in the same sense in which matter was a substance—an independent and self-existent reality which did not depend upon something else for its being. True, following the Greeks, later Christian theology said that in

the beginning God created both matter and souls, so that these two fundamental realities were no longer conceived to be eternal and uncreated, but this did not modify the inherent nature and influence of the Greek postulate of the absoluteness of the elementary particle.

After the Greeks, the history of physical science is the necessary unraveling of the consequences of this foundation idea as it was expressed through the forms of Aristotelian logic. The "mechanization" of the universe, the reduction of nature's phenomena to pushes and pulls of particles or systems of particles, was accomplished through the heroic efforts of the great geniuses of science—Galileo, Copernicus, Descartes, Newton, Kepler, Laplace, and others. God was banished from nature, or at least that part of it which was called the physical universe. Of course the next step, inevitable again, was the growth of a mechanistic science of living things and of human nature. This began with such men as Thomas Hobbes and René Descartes, and was completed (so they thought) by the modern Behaviorists, John B. Watson and others. These investigators sought "law" in human nature just as Newton sought it in the physical world. Deity (God) was then banished from the human kingdom, just as Newton and Laplace banished Him from the physical world. God then comes to reside outside the physical world and the human world. Then people are forced to choose between those who think that God is completely superfluous (the atheists) and those who find a justification for His existence by making Him a miracle-worker, a being outside nature who arbitrarily interferes with the "laws" of nature whenever He sees fit to work some "special providence" or divine intervention. Out of this background grew the so-called conflict of science and religion, which still rages now and then.

Before going further we must consider a question which becomes pertinent at this point. This question arises in connection with the problem of whether the mental evolution we have outlined is more closely associated with biological changes or with psychological-social processes. It is true that even the bare fact of such evolution is not established beyond all shadow of a doubt. There are two sides to the question. On the one hand Lévy-Bruhl has criticized the accepted anthropology (especially the English school) that tried to explain primitive man's attitudes, beliefs, and practices in terms of the logic of a much later civilization, as

if in a similar way one were to try to envisage the life of a child through the eyes of an adult. This procedure he warns against, explaining that primitive mentality is non-logical; it is not "illogical," because to call it such would be to apply logical tests to a mode of orientation which is outside all logic. But on the other hand, some able anthropologists, among them Franz Boas, believe that there has been little change in mental equipment, motivations, and mechanisms since the time of primitive man, who could be just as "modern" as modern man himself if he were placed in a modern environment.

My own view is that biologically "primitive man" probably did not differ much from man today. Of course that is true only within limits, for if we go back far enough—for example, to the Java ape-man (*Pithecanthropus Erectus*), who lived perhaps five hundred thousand years ago—certainly we will find that there are important biological differences. If we don't go back that far, but consider some of the later human types, such as Cro-Magnon man, who lived about twenty-five thousand years ago, it is clear that such primitive men had cortexes, even though they didn't use them very much. On this level "morality" was conformity to customs, folkways, social usage; and life proceeded in accordance with traditional or ancestral culture-patterns, so that inventiveness and intelligence played little part in the adjustments of the individual. Group consciousness predominates in primitive man. Subsequent changes have been due to the development of civilizations where there is a greater measure of individualism as an acceptable social norm. In extreme form this is found in the excessive individualism of the ancient Greek cynics (Diogenes, for example) and the skeptics and sophists of the Athens of the golden age of Pericles. In our own theory, therefore, we hold that the evolution of mentality (orientations or semantic reactions) is largely social, not biological, evolution.

That the classical laws of thought are indeed a reflection of social evolution, and that, specifically, the Aristotelian laws of thought express the cultural individualism of the Greeks, is indicated by the fact that other peoples (cultures) have not followed this individualism-identity principle. Some primitive peoples do not even have words for "I" and "you," but use the same word for both and designate the difference by pointing. Aside from such evidence, one may also refer to the "Report on the East-West

Philosophers' Conference" (See the *Oriental Institute Journal*, published by the University of Hawaii, Vol. 19, Feb., 1940). I quote from this report: "In the Orient, in nearly every one of the great systems, the individual is relatively unimportant and in no system does the individual possess eternal or ultimate reality in the form of immortality of the individual as such. In the West, on the other hand, he is accepted as real and significant practically throughout the history of Western philosophy—as well as in Christianity, perhaps the most widespread philosophical attitude in the West, where the individual is eternally real and ultimately valuable." This difference between Oriental and Occidental philosophy does not mean that the former is inferior to the latter, the report points out. I quote again: "In fact, the Oriental is vehement in his criticism of the shortsightedness of the West in its clinging to the individual as ultimate, whereas the Oriental thinks it quite obvious that the ultimate unitary principle of Reality is the true Reality." My quotation from this source is not meant to prove that the Oriental is right, but is only intended to indicate that in different social contexts the same orientations and semantics are not in operation. Whether the coming non-Aristotelian orientation will have anything in common with the Oriental evaluations is a matter which can be decided later.

Before we turn to the next and third level of semantics let us take note of the reasons for the collapse of the second level of human adjustments. Why is it that the civilization built around the two-valued Aristotelian judgments is disintegrating? There are many reasons, but suspicion about the futility of words and the feeling of inability to develop a new technique of communication is a fundamental part of our difficulty. Much of our so-called knowledge has turned out to be false-to-facts, and disputes among "experts" increase our distrust of our traditional intellectual authorities and sources of guidance. Eventually we have come to suspect not only the results that have been obtained, but the very instruments that have been used in obtaining these results. Throughout the world there has been a very real retreat from reason as an adequate tool of social action. The authority of scientific method is challenged in fact, if not in principle. Cynicism is the end-result of perpetual disillusionment. If we hadn't aimed at the impossible—eternal and absolute truth—and missed it so often, we might not so easily succumb to defeatism.

A second reason for the decline of Aristotelian semantics is more theoretical. In science the advent of non-Euclidian geometries and non-Newtonian physics has persuaded certain investigators to inquire whether the infallibility of the third member of the intellectual trinity, Aristotle himself, is not also open to suspicion. One of the truly great ideas that Korzybski has advanced is that the Aristotle-Euclid-Newton synthesis forms one coherent system, and the new orientation, the non-Aristotelian, non-Euclidian, non-Newtonian system, forms another and a more inclusive system which incorporates within itself the more limited scheme. In the course of time this will surely prove to be a very fertile suggestion.

V. Aristotelian Versus Non-Aristotelian Semantics

We now turn to several consequences of the Aristotelian orientation that are of supreme importance. The first consequence, already hinted at, is that Aristotelian logic and metaphysics established the doctrine which resulted in the dualism of "reason" and "emotion" as two separate phases of human nature. The second important consequence of Aristotelianism is that it gave a tremendous impetus to the semantics of personal identity (individualism). Both consequences deserve fuller discussion, and I shall indicate the historical significance of the second consequence before turning to the Aristotelian dualism of reason and emotion.

As one looks around for the causative factors responsible for the ills of modern civilization, the belief grows that one of them is selfishness—an excessive development of our feeling of self-identity and self-importance, which leads to a cultivation of our supposed self-interest. In an exaggerated form this is what we call "egotism." Both "nationalism" (certainly a great evil in modern society) and "rugged individualism" in the field of economics (what is called the system of "private enterprise," based on the "profit motive") are instances in the psychological-social field of what we have termed the fallacy of the absoluteness of substance (individuality). This is so if, and to the extent that, as we have previously asserted, the concept of the elementary particle was transferred to the soul and to the human personality. And on this point history is clear: it was literally correct for Descartes and others of his age to speak of the soul as a "substance" (*res cogitans*) just as it was proper to refer to matter as physical substance (*res*

extensa). To be sure, social egoism, as it exhibits itself in nationalism, class loyalties and hatreds, religious conflicts, racial pride, etc., involve the active functioning of what Korzybski has discussed under the term "identification." Here, as the basis for group conflicts, we must have a *projection* of the "self" into the group, or an *identification* of the "self" with the group. What semantics objects to here, I think, is not only the projection of an exaggerated ego upon the stage of social life, but the failure to realize that the smaller groups with which we identify ourselves can exist in our modern complex world of interdependent units only if we secure harmony and co-operation of the larger social groups.

If we fail to secure integration and social synthesis at the highest level, which is international co-operation, we shall all perish from too much conflict between smaller social units. If one wanted to be whimsical here, one might say that this is really a plea for the "higher egoism," as opposed to the lower. In making this suggestion I realize this involves a semantic abuse of language, since "egoism" is a relative term—that is, the words "I" and "mine" have a meaning only in the context of the "not-I" and the "not-mine"—and if in the highest unit, a world-state, there is no "other," there will be no social egoism behind the desire to serve and secure those universal human ends which benefit the highest social group, universal humanity as something above particular "races," "religions," "states," and "classes."

Now we return to the other consequence of Aristotelian elementalism, the schism separating reason and emotion, an opposition which has produced another fundamental cleavage running through modern society. The consequences in this second case are similar to those resulting from the previous cleavage of political-economic-religious-racial oppositions, due to ego-identifications and projections, except that the thing which makes unity and co-operation between reason and emotion difficult seems to come more from "within" than from "without." In both cases, however, tensions are set up which create impassable barriers. Of course the Aristotelians (and today there still are followers of Aristotle who believe that his was the greatest mind this world has ever seen) will object to our ascribing any oppositions, due to the "elementalizing" of human nature, to the influence of Aristotelian logic and metaphysics. Some of the followers of

Aristotle have objected to the tendency of some psychologists and educators to foist on Aristotle this doctrine of "faculty psychology" (as it is called), and have pointed out that Plato was more responsible for this psychology than any other single person. There is a certain amount of truth in this correction, but this must not obscure the fact that Aristotle's psychology, no less than his logic, is elementalistic, for Aristotle did distinguish between the functions of the "sensitive soul" (feeling) and the functions of the "rational soul" (reason); moreover, Aristotle's logic did encourage the creation of verbal fictions, which were then perpetuated through language by means of a never-ending stream of Aristotelian followers.

The foregoing analysis suggests that, so far as consequences go, there are good reasons for holding that the present impasse between sterile intellectualism and irrational emotionalism, a cleavage running through the whole of modern life and separating religion and politics from the life of reason, is the unfortunate social consequence of this elementalistic psychology and the cultural atomism which it helped to produce. In such a world of bifurcations the "intelligentsia" never seem to get anywhere, while the practical politicians do get somewhere, but they don't know where they are going, and after they get there they don't know where they are. But in an organismic or non-elementalistic view of human nature this social dualism and consequent mental-emotional conflict is resolved. You may, if you wish, call this type of semantics a psycho-logic, or even a system of psychiatry, except that it must be remembered that behind it there is a whole theory of nature.

There are those who say that emotion has no place in science, but this view expresses an inadequate psychology. What we need is not less emotion in science and in life, but a proper balance between emotion and reason. I suspect that the most productive and creative men of science have been those who possessed both intellect and emotion in an unusual degree. Our problem still is that of bringing the two together. In the older terminology this was the problem of reconciling the head and the heart, but in the light of our newer neuropsychiatry the conflict is really between the cortex and the thalamus, or more generally, between the new nervous system, the cerebral hemispheres (the "specific organ of civilization," as C. J. Herrick calls it), and the old

nervous system, the autonomic nervous system and the endocrine glands. In the earlier view of Head and Holmes the function of the cortex was to prevent affective over-response by the thalamus. In the more recent view of Korzybski the function of the cortex is to *delay* reactions so that we get a maximum of conditionality, based on the ∞-valued semantics of probability rather than the two-valued semantics of the Aristotelian orientation. But on either view we still seek for unity of personality—not the unity of a self-identical, permanent, pure, and immortal soul, but the unity of an integrated and dynamically synthesized personality moving forward through time with some purpose and some harmony between intellectual outlook and emotional satisfactions.

And this brings us to the next point. We have looked backward into the past in our survey of the mental-social evolution of humanity, and we have tried to project our vision into the future to get a glimpse of the coming semantics. One might well wonder whether there is any necessity, or thread of continuity, behind or inherent in the evolution of orientations. The answer, I surmise, is in the affirmative, in the sense that the new and coming insight into the unity of nature that we have hypothecated is a reflection in the world outside of a new integration within the human personality. That is to say, these two developments which come from the recognition of the defects of Aristotelianism, and the consequent substitution of a non-Aristotelian orientation, are two sides of the same situation. Integration is not something that takes place merely *within* the organism—it is a progressive interaction between an expanding environment and a growing organism. This triumph over the organism-environment antithesis is one victory over elementalism, and the synthesis of reason and emotion, the reconciliation of the head and the heart, will represent the second victory. In primitive man's orientation there is no sharp distinction between the subjective and the objective world; in the Aristotelian mentality, based on the law of identity, a sharp distinction between the "object" and its "environment" appears; on the third level, based on an understanding of an underlying unity provided by a sub-universe of continuity, the distinction between "object" and "environment" again becomes relative. Individual identity and permanence are to some extent illusory.

In this manner it becomes clear that principles of relativity and complementarity not only apply on the physical level, but are appropriate also on the human level. A field-organism treatment applies to *man* in *society* no less than to *particles* in a *field*—but we shall have more to say about this plenum dynamics in later chapters. On the coming level of orientations and evaluations we shall find that not only is man in society, but society is in man. This, it appears, leads us directly into a new humanistic emphasis. Perhaps when we have completely overcome elementalism in ourselves and found the higher unity in nature and society which we have found (created) in ourselves, we shall then discover that the only "deity" man will ever experience, or need to know, has its locus within the matrix of humanity in its common pursuit of higher and more inclusive adjustments and orientations.

In our own picture of the nature and possibilities of scientific humanism we reject the laissez-faire conception of man as a being whose problem it is to "adjust" himself to something already given, final, complete, and inexorable. We project creatively the curve of biological and human evolution, and envisage the emergence of a type of orientation for a coming humanity. We stress the fact that while this is the "projection" of a curve, the following of such a curve is not a necessary "law" of nature. The curve of human evolution through the three stages becomes a curve *only if we make it so*, and this can be done only by reinterpreting the past so that it becomes what a future possibility promises to mankind. In this manner history can be made meaningful, the past can be freed from the "pathos of time," and the future can then be rescued from social disaster. If man's task is to accept the challenge to make sense of that which otherwise threatens to become nonsense, he can do this only by remaking the past by fabricating a future. Man's greatest mission is now to salvage the pageant of history from the dark domain of the futile and insane, to snatch the human panorama from the frustration of the meaningless. How this is to be done is the problem and the task we have set for ourselves in the following chapters.

CHAPTER TWO

THE INFLUENCE OF ARISTOTLE ON HUMAN THOUGHT

Beyond a certain point clever people can never transcend the limitations of the social culture they inherit.

—LANCELOT HOGBEN

I. THE MASTER OF THEM THAT KNOW

As a result of modern high-pressure salesmanship many persons have come to believe that the newest is necessarily the best. This may well be true with radios and automobiles; but in religion and philosophy there still lingers on some confidence in the superiority of earlier models. It is for this reason that a knowledge of the history of human thought is invariably considered an essential constituent of a well-grounded philosophical training. This continuity of philosophy with its own past is illustrated by the fact that when a philosopher examines and evaluates an idea, he first of all goes back to the Greeks to see whether they had a word for it.

The philosopher trained in the history of human culture likes to point out that if we trace the civilization of contemporary western Europe back to its origins, we find that it stems from the culture of classical antiquity. Many books have been written commemorating

"... the glory that was Greece
And the grandeur that was Rome."

In investigating our debt to the ancients, we find that the dominating motifs of European culture have been two: science and political rationalism, both of them ultimately being phases of the search for a reasoned-out theory and practice, and both of which the Greeks gave us! Among the many great progenitors of our own culture a few giants stand head and shoulders above the rest.

And in this group we easily find Aristotle, "the master of them that know."

Aristotle was born in 384 B.C., in Stagira, a city in Macedonia several hundred miles north of Athens. Because of his birthplace, Aristotle is sometimes known as the Stagirite. Not much is known of the youth of Aristotle, though there are rumors of "fast life" in his earlier days. According to some accounts Aristotle went to Athens at the age of thirty to study philosophy under Plato Another version of the event states that he became the pupil of Plato at the age of eighteen years. Following the death of Plato in 347, Aristotle traveled around until called by King Philip to direct the education of his son Alexander. This relation between tutor and pupil was severed when Philip was murdered in the year 336 B.C. and Alexander was called to the throne. Aristotle then established a school at Athens—the Lyceum—where he taught. The Aristotelians were known as "peripatetics" because they learned their philosophy while walking in the groves of the school. After the sudden death of Alexander in 323, the philosopher was accused of sacrilege by the anti-Macedonian party at Athens, and was compelled to flee. He died in 322 B.C. at the age of sixty-two years. The greatest tribute that can be paid to this intellectual titan is to record the simple fact that within a span of threescore years he attained a more complete mastery of the learning of his age than any other thinker before or since his time.

We have ventured the guess that Aristotle was the greatest of the ancient philosophers. Some students might want to recommend Plato for this honored position, but if we are thinking in terms of *influences*, it would probably be admitted that Aristotle has had a deeper and more enduring influence upon two thousand years of European civilization than any other single individual, not even excepting the founder of the Christian religion.

Part of the explanation of Aristotle's mastery of the knowledge of his age is to be found in the fact that, quantitatively, there was much less to be known in those days. This, however, is not to be interpreted as a depreciation of the ability of a universal mind that was able to systematize and give coherent form to everything it touched. Aristotle wrote on every subject under the sun, and on some subjects that were not under the sun until he created them. His works were authoritative in many fields: logic, rhetoric, poetics, physics, botany, zoology, psychology, ethics, politics,

and metaphysics. This range of interests is indicative of Aristotle's versatility and insatiable curiosity. The explanation that is usually given of this interest in nature is that Aristotle was the son of a physician, and was therefore early in life brought into contact with the world of facts. Whatever the explanation, Aristotle enlisted the aid of assistants, scattered them around the shores of the Mediterranean, and then had them send in botanical and zoological specimens, which he classified and labeled. Thus the first step in the several natural sciences, the classificatory stage, was taken. Tradition has it that these researches were subsidized by Alexander the Great, who provided his former tutor with the equivalent of millions of dollars for his investigations.

II. The Aristotelian Influences

We are concerned with the influence of Aristotle on Occidental civilization In discussing this matter it is necessary to observe that this influence has manifested itself in two ways: (1) through the actual *content* of Aristotle's teachings, and (2) through the *form* (or logical structure) in which his systematic thought was expressed. In Aristotle's own thinking these were closely interwoven. History, however, has separated them, and some philosophers and scientists have used the one, the form, while relinquishing or modifying the other, the teachings or positive content, to suit their needs. We shall begin our discussion by following history in this respect, leaving it until later to see whether modern science, in rejecting Aristotelian metaphysics, must necessarily also reject Aristotelian logic.

In connection with the content of Aristotle's teachings we cannot of course go into great detail. We can discuss only briefly the most important ideas which have become a part of our intellectual heritage and environment. We begin our presentation with the metaphysics as the general background of the Aristotelian ideas in the field of the special sciences.

Metaphysics.—Aristotle distinguishes between the First Philosophy, which is concerned with universals and with *being* as such, and the Second Philosophy, which is the philosophy of nature. For Aristotle First Philosophy is what Aristotle's successors termed metaphysics. This, as just noted, is concerned with the generic traits of all existents. In this scheme the special sciences

as we now term them) therefore appear as *partial* philosophies. 'hus physics is concerned with being only in so far as it has, or xpresses, matter and motion. In this contrast between the two ypes of philosophy it is important to note that metaphysics is ıigher than the other sciences. Indeed, Aristotle identified this ubject with theology. And it is primarily because of this dentification that John Dewey[1] argues that Aristotle's philosophy s a systematization of Greek religious and artistic ideals. Since n the present volume we are also committed to the "cultural" nterpretation of the history of human thought, we must concur with Dewey when he affirms that the assumed superiority of the First Philosophy reflects the social prestige of a leisure class in ancient Greece whose supreme prerogative is contemplation.

We shall have more to say about these matters later. In the meantime we shall try to isolate and state the assumptions behind the metaphysics of Aristotle:

THE ASSUMPTIONS OF ARISTOTLE'S FIRST PHILOSOPHY

(1) Man, the rational animal, is the same always and everywhere.

(2) Human experience (perception, reason, emotion, etc.) is universally the same in humanity.

(3) The foundational structure of the universe is uniform in space and unchanging in time.

(4) By intensive and profound reflection upon any small area of nature, we can learn the truth about the universal features of reality.

(5) Knowledge is possible because thought and being coincide. Reason, the highest part of the soul, has direct intuitions. Truth is the agreement of these self-evident principles (the axioms of mathematics and the principle of contradiction) with the forms of reality.

(6) No special type of knowledge (such as is presented by the partial philosophies) can discredit the results of First Philosophy (or "metaphysics").

In the middle ages the Scholastics added the following assumption:

(7) The human intellect reached its supreme culmination in Aristotle.

[1] Cf. *The Quest for Certainty*, 1929, Ch. I.

And this in turn leads to the next proposition:

(8) The sum and substance of human wisdom is already embodied in certain great classical systems of thought.[2]

It is essential that the reader keep these assumptions in mind as we proceed. We now pass on to a statement of Aristotle's theories in the partial philosophies.

Botany and Zoology.—The best approach to Aristotle's natural science is through a study of Aristotle's theory of organic development It has been asserted by some writers that Aristotle was an evolutionist. On this point there is some doubt, which probably could be dissipated by a sufficiently restricted definition of the term "evolution." There can be little doubt, however, but that the actual effect of Aristotle's teaching in this field was quite the opposite. It is true that Aristotle believed that organisms grow and develop; he was one of the first "men of genius" to subscribe to the theory that the lowest stage of nature, the inorganic, passes into the organic, and that life originated in the inanimate world through a process of "spontaneous generation." All this tends to break down the barriers between the living and the non-living. He also held that there are plant-animal forms which bridge the gap, so to speak, between these two main classes of organic forms. But very definitely Aristotle did not believe that man had developed from the lower organisms, as the Darwinian doctrine of evolution affirms. Moreover, in asserting that there were clear lines of demarcation between the fixed types of organic forms, Aristotle enunciates a doctrine which, when coupled later with the Christian doctrine of special creation as stated in Genesis, provides a powerful impetus to an anti-evolutionary outlook on nature. (This linkage Aristotle was in no way responsible for.) In brief, Aristotle admits the reality of change and development within distinct species, but (with the exceptions previously noted) does not believe that one type of species evolves into another type.

There are three main classes of living forms, which Aristotle enumerates as follows:

Plants	Possessing the Nutritive Soul
Animals	Possessing the Sensitive Soul
Man	Possessing the Rational Soul

[2] It is the acceptance of assumptions (7) and (8), along with the previous postulates, that leads Dr. Mortimer Adler of the University of Chicago to his advocacy of Aristotelian Scholasticism in the philosophy of education.

Plants have a nutritive soul; that is, as living creatures they have the power to maintain and reproduce themselves, though they cannot feel. Animals have this soul, and in addition possess the sensitive soul, the power of sentience or feeling. Man possesses these two souls and also the rational soul. It is this which elevates man above the brutes to a position a little lower than the gods. This notion of the *soul* as an inherent principle of self-development is the key to the entire Aristotelian philosophy, and if we are to understand Aristotle we must comprehend what Aristotle means by the term

The Aristotelian philosophy is based on the doctrine that change and growth are a process of *realization*—the actualizing of that which is potential. The Aristotelian trinity of potentiality, movement, and actuality expresses a theory of how the ideal *form* controls the *matter* to achieve the end of perfection Aristotle's teleological theory says that living creatures develop toward more nearly perfect forms because the inherent principle of self-perfection strives to actualize its capacities. *On this theory the soul is the form of the body*; it is the unity and harmony of functioning toward which bodily processes strive. When we try to relate this conception to modern theories of development, we raise the question of whether Aristotle was a "mechanist" or a "vitalist." Hans Driesch, the eminent German philosopher and biologist, interprets Aristotle's theory in such a way as to bring him into line with vitalism, for Driesch takes over Aristotle's term "entelechy" (from the Greek *telos*, meaning purpose or end) as a name for the vital force, the existence of which Driesch thinks he has established by experimental biology. But E. B. Holt, in his *Freudian Wish in Ethics*, regards Aristotle as a good Behaviorist, because Aristotle's conception of the soul as the form (integrated behavior) of the body is quite in harmony with the Behavioristic scheme. The truth of the matter probably is that Aristotle is neither a mechanist nor a vitalist in the present meanings of the terms. It must not be overlooked, however, that Aristotle's system as a whole is anything but materialism in any sense of that term (ancient or modern), for his conception of God as the eternal Form of Forms is absolutely essential to this system. God is the uncaused cause, the prime mover, in terms of which all else is explained. Thus we see how thoroughly First Philosophy and theology permeate what we now call the natural sciences.

Astronomy and Physics.—Aristotle's astronomical theory is complicated and rather obscure. It is generally admitted by all modern Aristotelians that this is the least fortunate phase of Aristotle's philosophy. And yet, as I shall try to show, this is a vital part of the Aristotelian system

It is generally known that the geocentric theory of cosmology is associated with the name and the authority of the great Stagirite. According to Aristotle's scheme, starting with the earth at the center of the universe, we find that as we proceed outward we pass in concentric layers through water, air, and fire to the celestial spheres, composed of ether, which bear the planets and the sun around the center. At the outermost confines of space is the sphere of the fixed stars. Here at the periphery we find God, as far removed from the earth as possible. In a logical role God appears in Aristotle's system as the unmoved mover, the first cause, because Aristotle objected to an infinite regress in causal explanation; but in emotional terms (particularly as interpreted in later Christian doctrine) God is the supernatural, immortal, unchanging and everlasting cause of all the heavenly motions. However, even though Aristotle holds the planets to be inferior in dignity to the fixed stars, these planets are likewise immortal beings, supplied with a spirit to move them. Aristotle's polytheism, as one might call it, here leads him into astronomical difficulties, for the movements of the planets, not always in harmony with the divine movement of the sphere of the fixed stars, is the result of the "individualism" of the lesser gods in relation to the supreme Deity.

It is common knowledge that Aristotle's theory, placing the earth at the very center of the whole system, was adopted by Ptolemy, who lived in Alexandria in the second century A.D., and that the Ptolemaic cosmology was later taken over by the church as the approved doctrine. The reasons for this are readily seen. Aristotle's contrast between the natural and the supernatural, earth and heaven, the temporal world of change and the eternal world of God, could easily be fitted into the later Christian conception, even though in the process of theological adaptation some phases of Aristotle's system had to be reinterpreted. Aristotle's conception that all things strive for perfection appears in his astronomical theory when he adopts the principle that the circle is the perfect geometrical figure, and then concludes that the

heavenly bodies must therefore revolve around the earth in circles. Even Copernicus, the originator of the modern heliocentric theory, accepted this remnant of the Aristotelian cosmology, and it remained for Kepler to destroy this survival in his laws of planetary motion. In other respects, however, Kepler did not completely free himself from the traditional influences. His interest in astrology, his mathematical mysticism, and his absorption in the Pythagorean "music of the spheres"— all these are vestiges of Greek mathematics and natural philosophy. Some of this is Pythagoreanism and Platonism, but much of it is also Aristotelianism. Just as Aristotle's personification of the heavenly bodies lent support to astrological speculations, so Aristotle's approval of the current Greek doctrine of the four elements (earth, air, fire, and water) could be and was used by the later alchemists to support and rationalize their doctrines of transmutation. Indeed, there was a close interrelation between alchemy and astrology. It may be wrong to describe alchemy as the "child of Greek philosophy," but certainly there is a blood kinship.[3]

The historical importance of Aristotle's ideas in these and other fields, we repeat, cannot be exaggerated. Later on we shall note the philosophical and scientific consequences of the geocentric-anthropocentric doctrine. Here we content ourselves with emphasizing that Aristotle's views lent themselves readily to the purposes of later theology, and with noting that the medieval church probably did not distort the framework a great deal in its adaptation of the Aristotelian system. Well might the theologian heartily welcome the teaching of The Philosopher that plants exist for animals, and animals for man, and conclude that nature, which does nothing in vain, has done all things for the sake of man.

Ethics and Politics.—The implications of Aristotle's theory of development ramify into all branches of his system. In ethics the notion of growth as a realization of perfection reappears in his theory of energism or dynamism. Ethics is the science concerned with erecting standards of conduct. In human beings, it will be recalled, the perfect form is the rational soul. Man at his best is a rational animal, and his highest type of expression is reasoning. Aristotle here continues the intellectualistic tradition of Plato; but Aristotle takes a saner attitude (as some would

[3] On this matter see Ch. XXII.

term it) toward the emotional elements in human nature. The good life, for Aristotle, consists in giving expression to all the innate capacities of human nature. One is functioning as a whole individual when he realizes all of his potentialities. In such a life everything has its place, but nothing is indulged in to excess. This classical view is sometimes termed the doctrine of self-realization, and it is still with us as one of the important types of ethical theory.

Aristotle disagreed with the hedonists, who held that the pursuit of pleasure is the goal of life. Aristotle argued that virtue is the thing we should pursue, but he was no sour-faced ascetic who thought the virtuous man is unhappy in this world. Pleasure, he holds, is a byproduct of the good life; it is a sign of the successful functioning of the organism in the realization of its capacities. When we achieve what we set out to do, when we give expression to our abilities, we are happy in the process.

An important aspect of Aristotle's ethical theory which follows directly from what we have said is summed up in the famous doctrine of the "golden mean." We should pursue virtue: but what is virtue, you ask? Virtue, Aristotle answers, is a mean between extremes. Several illustrations of this are as follows:

Gluttony	⟵	Temperance	⟶	Self-denial
Foolhardiness	⟵	Bravery	⟶	Cowardice
Extravagance	⟵	Liberality	⟶	Miserliness

With the exception of reason, which is not a mean and which cannot be indulged in to excess, all virtues lie between their opposite extremes. Any man can go to excess. It takes good judgment to exercise a capacity and yet know when to stop. Intelligence is necessary to adjust one's impulses so as to secure a well-balanced life. Any sentimentalist can give all he has to charity, and any miser can be stingy, but only the man of good judgment can discern when charity overreaches itself and becomes a defect. Thus we find Aristotle agreeing with his teachers, Plato and Socrates, who affirm that only the intelligent man can be good. To have generous impulses, human sympathies, and good motives is not enough.

For Aristotle the good life is the communal life. It is the function of society to help the individual to realize his best potentialities. Man is a social animal. It is only through co-operation

with others in society that we can give expression to our abilities. Aristotle sees no necessary conflict between the individual's interest and group welfare. He would not agree with those individualists and philosophical anarchists who think that society is a monster or Leviathan swallowing up the "rights" of persons. Of course, as Aristotle points out, not all states or political organizations are equally good. In keeping with his conception of man as a rational and a political animal, Aristotle makes an analysis of the different types of political state, and comes out in favor of the belief that a middle-class state is best. Here his doctrine of the golden mean reappears in his political philosophy. Those who possess an average amount of property are the most law-abiding citizens. The excessively poor and the very rich are most likely to violate the law, for different reasons. The greatest danger to the state is extremes of wealth and poverty. The cause of political revolutions is inequality, which is lack of balance.

Most of the Aristotelians regard Aristotle as much more of a "realist" than the utopian dreamer Plato. Aristotle's sanity, as they regard it, is also manifested in his attitude toward art. Plato was an extremist; he was a puritan and an ascetic. But Aristotle, son of a physician, thinks that too much repression is bad. In his theory of art he therefore asserts that the true function of art is to provide an outlet for our emotional nature. Art is a vicarious cleansing of the bosom of "perilous stuff," which would otherwise accumulate like poison. Tragedy, for example, by providing an escape for the emotion of fear, rids us temporarily of this feeling. Art, therefore, is a purgative. This is Aristotle's well-known theory of catharsis, which has caused much discussion among the experts in esthetics.

Having thus outlined—sketchily but not inadequately, I hope—the main contributions of Aristotle to the special sciences (or partial philosophies), we now turn finally to a statement of his logical theory.

Logic.—Here Aristotle's contribution is outstanding. Aristotle did for deductive logic what Euclid did for geometry, and probably Euclid was much indebted to Aristotle, though this matter has never been sufficiently investigated. Aristotle gave us a systematic exposition of syllogistic reasoning, the traditional form of deductive inference, and not much has been added to Aristotle's treatment, except that, as we shall see later (Chapter XVIII),

symbolic logic has been added on to the older forms. It is important to note that the idea that Aristotelian logic is exclusively concerned with deduction is false, since Aristotle did recognize and discuss inductive inference. It is also important to keep in mind that Aristotelian logic is now defined in terms of the "laws of thought" that we have previously referred to and shall discuss at greater length in the pages to come. This influence of the "forms" of thinking which Aristotle superimposed on Western science and philosophy is the most subtle and enduring phase of Aristotelian thought.

After the break-up of classical Greek culture, little was added to philosophy or science until early modern times. The Romans were empire builders and not philosophers. The only possible exception to this statement comes in connection with Stoicism, which, through its influence on Roman law, made an important contribution to the culture of western Europe; but this is not the place for a consideration of that matter. Rather must we now turn to an investigation of the influence of Aristotle in Europe during the Middle Ages, particularly as that influence has affected the modern world.

III. From Medieval Thought to Modern Science

It is generally known that during the Middle Ages Aristotle became a kind of infallible pope of secular learning. The culture of the Middle Ages reached its peak in the thirteenth, the "greatest of the centuries," and is summarized in its most systematic form in the writing of Thomas Aquinas, the greatest of the Catholic thinkers. The philosophy of the Schoolmen, known as Scholasticism, was a synthesis of Christian theology and Aristotelian logic and natural science. This synthesis was so imposing and widely accepted that it still continues on in the Roman Catholic Church in the form of the Thomistic movement.

The position of Aristotle in the Middle Ages is perhaps best summed up in the phrase of Dante, who termed Aristotle the "master of them that know." Dante was in a peculiar dilemma. He had an enormous admiration for Aristotle, but because Aristotle was an unbaptized pagan, he could not, in the scheme of the *Divine Comedy*, put him in paradise. The best that he could do was put him in limbo; suspended midway between heaven and hell, where the great pagan fared not so badly. So great

was the authority of Aristotle with the medievals that if any new ideas were suggested, their value was tested by seeing first of all what Aristotle had to say on the subject. The apotheosis of Aristotelianism was found at Oxford University, where Aristotle was studied on bended knee.

This assumption that everything that could be known, and was worth knowing, was already known—and in fact available in the scholastic system—explains the lack of experiment and observation in medieval culture. It explains the exclusive use of deductive logic. If your premises are given (by revelation and authority), all you can do is to deduce the detailed consequences of these generally accepted propositions. For example, given the existence and omnipotence of God, it is a valid question to discuss whether God could make a yardstick without two ends, or a valley without two hills. Or again, granted the existence of angels, it is a legitimate problem to investigate whether they occupy space, how many could dance on the point of a pin, and so on. Modern science still employs the same deductive method of thinking, except that it insists upon a different technique for arriving at its stock of premises. The difference between science and medievalism is one of addition and not of subtraction. Deductive thinking has not been discredited or dropped, but has been put in its proper place.

It is commonly supposed that Francis Bacon was the founder of inductive thinking, the logic of experimental science. But this is a mistaken view. By the time of Bacon, modern science was already started on its perfectly amazing career. Vesalius, Copernicus, and others were in no way indebted to Francis Bacon. What Bacon did was to rationalize a movement already under way. His *Novum Organum*, or new instrument of reasoning, pretended to be a step beyond the *Organon* of Aristotle, but in reality it was a return to the use of an instrument which had fallen into disuse during the Dark Ages. That Bacon, in his reaction against medieval Aristotelianism, was not a prophet crying in the wilderness is indicated by the following lines from John Locke:[4]

> If syllogisms must be taken for the only proper instrument of reason and means of knowledge, it will follow that, before Aristotle, there was not one man that did or could know anything by reason; and that, since

[4] *Essay Concerning the Human Understanding*, Bk. IV, Ch. XVII.

the invention of the syllogism, there is not one of ten thousand that doth. But God has not been so sparing to men to make them barely two-legged creatures, and left it to Aristotle to make them rational.

The general belief is that modern science had to do battle with and overcome Aristotelian medievalism before it could get started. The outstanding historical instance of this conflict is supposed to be the fight between Galileo and his Aristotelian antagonists in the universities. Here we have in mind the story of the alleged experiments of Galileo from the Leaning Tower of Pisa. The traditional account has it that Aristotle's law of falling bodies made velocity directly proportional to weight, and constant, and that this law was upset when Galileo showed that, making allowances for differences in air resistance, bodies fall with accelerated velocity independently of weight. This story, which is always told with so much gusto by Bertrand Russell, has become so much a part of tradition that it comes as a shock to learn of its possible untruth. The first systematic attempt in English at refuting the historicity of this event is found in Lane Cooper's book, *Aristotle, Galileo, and the Tower of Pisa* (1935) In this study Lane Cooper assembles the evidence to show that Viviani's story about Galileo's dropping weights from the Tower of Pisa to refute Aristotle's law of falling bodies rests upon a misunderstanding. It was Coresio, an opponent, who dropped the weights, and he was interested in verifying an alternative interpretation of Aristotelian thought. Lane Cooper argues that "the scientific attitude to physics begins with Aristotle and no other man." As one reviewer[5] says, "The father of modern science turns out to be none other than the master of them that know."

Professor Randall's judgment about this matter may be correct, but there still remains another item to be considered before we balance accounts. This arises out of the possibility that the Aristotelian influence started science off on the wrong foot. One of the best-known expounders of gestalt theory, Kurt Lewin,[6] has developed contrasts between the Aristotelian and Galilean modes of thought, and argues that modern science must cast its fortunes

[5] J. H. Randall, Jr., *Journal of Philosophy*, 1935, Vol 32, p. 584.

[6] Cf. "The Conflict Between Aristotelian and Galileian Modes of Thought in Contemporary Physics and Biology," *Journal of General Psychology*, 1931, Vol 5, pp. 141–177. (Sometimes Lewin spells "Galileian" with an *i* and sometimes he omits it. I shall follow the latter practice in my own use of the term.)

with the latter and renounce Aristotle if it is to succeed in its explanations of natural phenomena.

Summarizing our conclusions up to this point, we may state that even though we recognize that there is room for difference of opinion on these matters, it still is clear that in terms of *content* of doctrine modern thought finds much in Aristotelianism, ancient and medieval, which is definitely false or inaccurate and therefore stands in need of replacement or emendation. Of course there is much in Aristotle's views (philosophy) that is substantially sound and of permanent value. This, however, is not the point at issue. We are concerned with the *influence* of Aristotelianism, and this is something quite apart from the positive content of Aristotle's own philosophy. This point is so important that it deserves to be stressed.

The contrast between Aristotle and what has come to be known as Aristotelianism is sometimes so remarkable that one might well say, that if Aristotle had lived in the Middle Ages, or for that matter in modern times, he would not have been an Aristotelian! The true follower of Aristotle is one who is loyal to the spirit and the method of Aristotle and not to the letter of his texts. In other words, a modern advocate of non-Aristotelian logic may be a truer apostle of the master than those contemporary advocates who render lip service to Aristotle and his teachings and study his works in a spirit of pious humility. Aristotle himself had too great a respect for intellectual independence and for the authority of facts to demand an eternal allegiance to a system of philosophy. He would have been skeptical of the medievalism which taught his doctrines as part of a pre-Christian revelation. Just as it was no fault of Jesus' that church councils solidified the ethical insights of his spiritual genius into a hard-and-fast system, so it was through no fault of Aristotle's that he became an infallible prophet of nature and of science. Both Jesus and Aristotle were individualists, but their followers have been the most servile of intellectual acolytes. Aristotle, we repeat, was no slave to human authority, revelation, or tradition. He rejected one of the most fundamental theses of his own teacher—Plato—and used the ideas of his predecessors as stepping stones in the construction of a new system. Those ancient moderns who decry the present eager interest in novelty should always remember that the ancient Greeks were also interested in novelties and were eager for pro-

gress, as Pericles himself recognized. Eternal revelations have no place in a world dedicated to the "Unknown God."

In view of these facts, is it too much to say that the medieval synthesis—the Aristotle-Aquinas hookup—is responsible in no small measure for our inability to solve our modern problems in terms of the new conditions peculiar to the modern world? Weighted down by the inertia of the past, modern man is unable to walk upright into the dawn of the new day. Traditionalism, mental habits, and social epimetheanism have taken their toll in the devitalizing of our creative energies. The great disservice of Aristotelianism is that it has put men into the attitude of looking to the past for understanding, so that our own native capacities languish for lack of use.

The fundamental assumption of the doctrine of the verbal inspiration of the prophets of religion and philosophy is inevitably tied up with the type of Aristotelianism we have been discussing. The inescapable consequence of this point of view, pushed to its limit, is that *we are living in a completed universe*. Moreover, the belief in truth revealed in some golden age of the past leads us to be skeptical of future biological evolution and social progress. Even though, as previously noted, in his biological theory Aristotle is sometimes looked upon as an evolutionist, it is not entirely accident that scholasticism gave us the synthesis of the Aristotelian doctrine of forms (eternal types) and the special-creation theory of Genesis. The outcome of this alliance was the creation of the "immovable object" against which the "irresistible force" of Darwinism had to pit itself. In its social implication this biological underpinning of eternal and changeless forms commits the Aristotelian to a kind of laissez-faire politics and ethics. Quite appropriately, therefore, the followers of Aristotle frequently pride themselves on the "objectivity" which frees them from what they regard as the "partisan" causes of "moralistic" ventures. To some extent Aristotle himself is responsible for this superiority to "reform" movements, for in his conception of God pure contemplation is exalted as the sole preoccupation of Deity, and man is most godlike when he too is engaged in contemplation.

IV. Aristotelian Logic and Metaphysics

The foregoing survey, in sketchy outline, presents something of the content of Aristotle's philosophy. It conveys some idea of the historical significance and impact of his teachings. But more

important than this, we find that for twenty-five hundred years Greek language and logic have provided the skeleton around which the flesh and blood of science and philosophy have evolved. Next we must consider at more length this second phase of the Aristotelian influence. The influence of the abstract forms guiding and controlling human thinking is more subtle, less obvious, and by all odds the most enduring and significant phase of Aristotle's teachings. In the following chapters we shall consider in detail this second phase of the problem, but to help clear the ground let us here remind ourselves of the intimate relation these two phases of his system sustained to each other. Today we can separate logic and metaphysics, but it is doubtful whether Aristotle himself thought of these two as separate and independent interests.

The necessary justification for this last statement can be found almost anywhere in Aristotle's system, but to pin the matter down, note that in the *Metaphysics* Aristotle says that the First Philosophy inquires into the nature of being as such—the eternal essence of things, as opposed to the relative and accidental. Now, according to Aristotle, the essence of things is to be found in the class properties, and not in the individual properties. And in Aristotle's subject-predicate logic—as we shall see later—all things that we can speak of are members of classes, and all natural classes have common elements. This element which all members of any given class have in common is the aforementioned "essence." If these "classes" are interpreted as types or "species," Aristotle's theory very easily developed into an anti-evolutionary philosophy, for Aristotle assumes the eternity of classes and essences, in the past as well as in the future. *It is the function of logic to investigate these principles of being, these most general features of any and all subject matter.* In one direction this leads to Aristotle's famous list of "categories," and in the other direction it culminates in formal logic as the science of the principles that we use in reasoning in some particular field where those categories apply.

This close connection between logic and physics implies nothing as to the temporal priority of either. Like form and matter, they are inextricably interwoven, and logic is in no sense a creative agent in causing physical realities. As Aristotle says, "A true sentence is by no means the cause of the thing's existence, but in some way, the thing appears to be the cause of the sentence being true, for a sentence is said to be true or false according to whether

the thing does or does not exist."[7] This, it is clear, provides little justification for those verbalizers who have always tried to deduce the nature of the world from the supposed implications of linguistic juxtapositions, and yet the subsequent history of philosophy in western Europe is in a large measure devoted to this very undertaking.

It is not to be held against Aristotle that later Christian theologians used Aristotle's distinction between the domain of nature and the domain of the supernatural—the earth placed at the center of the world and God placed at the periphery—to justify the opposition to Copernican astronomy; nor is it to the discredit of Aristotle that his theory of fixed types in nature should also provide the justification for the opposition to the evolutionary theories of the "origin of species"; but the historical fact remains that it was the "Aristotelians" who in both cases impeded the progress of science and stifled freedom of thought. It is for this reason that we look upon contemporary "Aristotelianism," the worship of the letter rather than the spirit of Aristotle, as one of the menaces to the future evolution of the human intellect. The world does move! And to see in what direction the human mind is moving we now enter upon an examination of these new non-Aristotelian developments.

[7] *Categories*, Ch. 12.

CHAPTER THREE

NEW PATTERNS OF ORIENTATION

The belief or unconscious conviction that all propositions are of the subject-predicate form—in other words, that every fact consists in some thing having some quality—has rendered philosophers incapable of giving any account of the world of science and daily life.

—Bertrand Russell

The subject-predicate habits of thought . . . had been impressed on the European mind by the overemphasis on Aristotelian logic during the long medieval period. In reference to this twist of mind, probably Aristotle was not an Aristotelian.

—A. N. Whitehead

I. Organismic Logic

Modern civilization is approaching the end of an era. For twenty-five centuries the human intellect has been guided by the axioms of that great creator of Western culture whom the medievals designated as The Philosopher. Now we face a new era of thought, an age of non-Aristotelian orientation. Just as the old logic, and the science and philosophy resulting from it, were connected with what may be termed the fallacy of the absolute individuality of the subject, so the coming age of culture, when and if it emerges, will be characterized by a new type of reasoning based on a logic of parts and properties within dynamically organized wholes.

We have described the old logic as a logic of absolutes. That this mode of thinking is a consequence of the subject-predicate habit of thinking—or, more fundamentally, an unfolding of the grammatical forms of the Indo-European family of languages—is a theory that will be discussed in more detail later. For the moment, we do not attempt to justify or amplify this theory. Rather let us here consider an instance to illustrate how present

problems and perplexities have been created by the type of logic we have been using for these long ages.

Assuming the truth of an atomistic (elementalistic) analysis, science has been forced to seek for the cause of integration, growth, and evolution in certain supposed and ever-elusive binding forces which unite the parts, while at the same time it has always experienced difficulty in synthesizing the analytical parts and in understanding the further evolution of the wholes thus produced. Whether, somewhere near the "bottom" of nature, we attempt to derive the properties of molecules (or a molecular continuum) out of a compounding of the properties of the elementary constituents (atoms); or whether, somewhere near the "top" of nature, we attempt to account for the social features of humanity in terms of atomistic notions (reflexes, sensations, etc.), we face the same difficulty. Perhaps behind this difficulty is the most important fact that man has placed an undue emphasis upon his own individuality, has failed to see that the separation of the organism from its complex environment is fallacious, and consequently has artificially dichotomized nature through isolation of subjects of abstraction. The illusion of selfhood is one form of the fallacy of the absolute individuality of the subject, mentioned above.

When, in the light of new insights, we look at man in his physical and social environment, these fallacies of "simple location" and "misplaced concreteness" (Whitehead) appear for what they are—an oversimplification which modern knowledge can no longer approve. Man lives in a geo-cosmic environment which is extremely complex. Some of the parameters are these: an air-pressure environment of fifteen pounds per square inch, with a highly constant oxygen concentration; a temperature gradient the limits of which, on a scale of absolute degrees, is quite narrow; a gravitational field which regulates and limits the character of our responses, if it does not also regulate the velocity constants of the chemical reactions in the body; and even cosmic rays, which are disintegrating millions of atoms in the human body every minute, the consequent radiations possibly acting on the synapses to influence our reaction-time velocities. Change any of these and man ceases to be man: he behaves like a vegetable, or even dies. For example, alter the oxygen concentration and man loses consciousness. Breath is life, or *respiro ergo sum*, as William James

said; but as John Dewey somewhere points out, breathing is as much a matter of the air as it is of the lungs. Where, then, is the line of demarcation between the "organism" and the "environment"? Certainly it does not stop at the skin. And the beginning and end of the social environment is still less distinct. We live in a cultural field, a milieu of folkways, institutions, laws, and human group patterns of behavior which extend indefinitely into space and time. Atomism fails most obviously at this point. Is it any wonder that the Utilitarians found it difficult to derive a theory of moral obligation and social responsibility from the elementalistic definition of man, stated in terms of the individualistic hedonism of the pursuit of private pleasures? The fact is, that man is social first of all, and is an "individual" only derivatively. The Utilitarians were struggling with a pseudo-problem, created by an atomistic definition.

Here, in the social field, it is interesting to note that Aristotle was somewhat less of an Aristotelian than his own followers. For Aristotle starts out with the definition of man as a political animal, and recognizes that in this case the whole (society) precedes the parts. But our modern ethical problems are incapable of solution until we eliminate that phase of Aristotelianism which leads to the fallacy of the absolute individuality of the subject which we have inveighed against. For that matter, the same insight into the difficulty created by the logic of absolute individuality was attained by Jesus. His injunction that he who would save his life must lose it might present an adequate solution to the problem of personal morality, were it not that in a modern complex society one does not know what groups and causes provide the best media through which to lose one's individuality. In the case of Jesus the surrender of the individual to the larger whole is based upon an intuition of the unity of mankind which arises primarily out of an emotional experience. The older appreciation of the unity of the individual with the species (one form of "atonement") rests upon emotional fact, possibly an animal instinct. The newer unity of mankind must be a result of an intellectual intuition. To attempt to secure the unity of mankind through a return to the older forms is a resort to cultural atavism. The next forward step in evolution is to seek to attain this unity on a higher level. This cannot come through a negation of reason. If

we can avoid the anti-intellectualism of Bergson's philosophy, we might say that the new insight must result from a transmutation of instinct into intuition.

Our statement that to resolve our social maladjustments, and systematize the empirical discoveries of present-day science and adequately handle the theoretical problems which grow out of these findings, we shall need to reformulate the methodology of modern thought, is in harmony with the thesis of Count Korzybski, who argues at length[1] that what is now needed is a reformation so radical that the traditional "laws of thought" will have to be modernized, or even eliminated. The statement that we need to change the fundamental assumptions of modern science will, of course, not go unchallenged. Undoubtedly there are many scientists—the empirical grubbers, for the most part—who will refuse to recognize the necessity for such a reorientation. Such scientists are still unaware of one of the curious paradoxes of modern thought; namely, that while science in the course of the last several centuries has progressively extended man's power of control over nature, it has also, in recent years at least, been undermining its own position as a theoretical discipline. After verifying Francis Bacon's dictum that knowledge is power, modern science is beginning to learn that power is not necessarily knowledge. In support of this statement, reflect on the fact that while science has extended its ability to predict and control the future, we have no adequate theory of "natural law" to explain and justify these results. As the writer points out,[2] the status of induction, causality, probability, etc., is a scandal in the contemporary philosophy of science. Let us now present and examine a few of the "contradictions" in modern science, with the purpose in mind of then discovering how these oppositions have come about.

II. Some Contradictions in Modern Science

We have stated that science faces a crisis which will discredit it as a theoretical discipline, unless it finds a way to resolve the difficulties and paradoxes which confront it. In order that this statement may not appear unfounded, let me select from a larger

[1] *Science and Sanity, An Introduction to Non-Aristotelian Systems and General Semantics*, by Alfred Korzybski, 1933, the Science Press.

[2] Cf. *Philosophy and the Concepts of Modern Science*, 1935, Introduction and Ch. III.

list certain examples of antinomies which have appeared within the domain of natural science in recent years. These are stated as contradictions, and adopting the Hegelian pattern, we present them in the form of thesis and antithesis (see Table Two). The evidence for each member of the pair of contradictions is part of our present-day "knowledge," and in the last instance is a "fact" of direct experience (introspection). I shall not attempt to summarize the evidence at this point.[3] The first six antinomies are instances of "truths" conditioned by physical relativity. The eighth antinomy is an instance of chemical relativity; the ninth of biological relativity; and the tenth of psychological relativity. The basis for these instances of relativity will be suggested in the

TABLE TWO

Thesis	Antithesis
1. An electron is a corpuscle.	1. An electron is a wave-phenomenon.
2. Radiation is undulatory.	2. Radiation is corpuscular.
3. The ether exists.	3. The ether does not exist.
4. The ether (field) is continuous.	4. The ether (space-medium) is discrete.
5. The velocity of light is constant.	5. The velocity of light is variable.
6. Every material body gives rise to an electromagnetic field.	6. Every material body does not give rise to an electromagnetic field.
7. The color of this star is red.	7. The color of this star is blue (not red).
8. This solution is electropositive.	8. This solution is electronegative.
9. This cortical neurone is active.	9. This cortical neurone is passive.
10. The taste of this apple is sweet.	10. The taste of this apple is not sweet (is sour).

following pages, though in general the assertion of either the "thesis" or the "antithesis" as a truth in itself is an example of the previously mentioned fallacy of the absolute individuality of the subject, which is engendered by the law of identity. One way of exhibiting a proof of our previous statement that the new methodology of science calls for a non-Aristotelian systematization consists in showing that these "contradictions" arise out of a mistaken application of the law of identity, and that the resolution of these antinomies therefore calls for an abandonment of the ontological application of this great "law."

[3] The supporting evidence and the implications of this evidence are presented in "Physical Relativity and Psychical Relativity," *Psychological Review*, 1930, Vol. 37, pp. 257–263; "Relativity and Reality," *Monist*, 1931, Vol. 41, pp. 512–543; and "Biological Relativity," *Journal of Philosophy*, 1931, Vol. 28, pp. 701–714. See also Ch. XV of the present volume.

The difficulties encountered in trying to reconcile "thoughts" and "things"—as illustrated in several of the foregoing antinomies—are a result, in part, of the fact that the human thinker can do something that the unthinking matter cannot do: by definition, he can fixate the "essence" of a thing or class. This is the intellectual analogue of what the biologist does when he "fixes" a preparation by staining. This procedure is intimately tied up with the Aristotelian subject-predicate logic, as we have already noted. By this procedure realities which are fundamentally functional or behavioral facts of nature are reified and hypostatized by language into substantial, self-identical "things-in-themselves."

The type of definition that is peculiarly appropriate to the subject-predicate mode of thinking is "nominal" definition. A purely intensional logic will define the terms employed in propositions by statements of the connotations of the terms (words) used. Employed exclusively, this leads to definition by postulation, and to the purely verbal (symbolic) discipline of a non-empirical science, such as formal logic. This type of definition would cause us no trouble provided we operated exclusively on the level of "concepts," and did not face the necessity of referring our "thoughts" to the world of things, the perceptual world of "concrete objects." It is because we must use verbalized thoughts in our orientations that we get into difficulties. Words and symbols must denote as well as connote. For this reason our semantic reactions (meaningful adjustments) must have extensional reference as well as intensional meaning. But before going further let us set down the contrasts between these two modes of definition:

Intensional Orientations	Nominal or verbal definition Connotations emphasized Non-empirical field, with no "facts" Definition by postulation
Extensional Orientations	Real definitions employed Denotations emphasized Empirical science, based on "facts" Definition by inspection

It is because of the existence and use of these two modes of "thinking" or orientation that we get into difficulties. Function-

ing in a "twilight zone," somewhere between the level of pure intension (or connotation) and pure extension (or denotation), we try to avoid confusion by observing the principle: "Render unto God [pure intension] the things that are God's, and unto Caesar [pure extension] the things that are Caesar's"—only to get lost in a bewildering confusion which results from the fact that we no longer know which words belong to what kingdom! Undoubtedly both God and Caesar must be dismayed by the consequent chaos. The situation is twice confounded by the fact that *men will persist in the belief that because they have a word, there must be a reality which corresponds to that word.* Thus through reification and projection of subjective constructions we create verbal fictions; by abstraction and hypostatization of our ideas we make things out of functions or modes of behavior. This is illustrated by such terms as "consciousness," "force," "space," "justice," "democracy," "liberty," and many others. In general we give to airy nothings a local habitation and a name. This is quite harmless in poetry, but it works endless confusion in science and in politics.

We have already pointed out that the contradictions in scientific thought are in part a result of definition by fixation. The existing difficulties are also in part due to the fact that in all our thinking there is an inevitable element of anthropomorphism. That is, all scientific analysis contains, or is the result of, abstraction. The human element enters in the process of selection whereby we isolate and study the "objects" and the "phenomena" of nature. This is inescapable because even visual perception involves sensory abstraction of an object—the "figure" of gestalt theory—from its background. This sensory abstraction of percepts reflects itself in the domain of concepts, where we formulate and express verbally the connotations of the terms symbolizing the abstracted entities. But we must never forget the wider context or environment within which "things" reside. In the biological world this fact that any organ, such as the heart, or brain, or stomach, is a part of an organism-as-a-whole situation is not easily overlooked, and so there we are not so likely to think in "elementalistic" terms. What we are more likely to overlook is that these same non-elementalistic and non-additive situations occur even in the inorganic world. As Count Korzybski points out, the Einsteinian doctrine of relativity brings out the *non-additive* character of one

physical situation in emphasizing that the familiar additive formula for the compounding of velocities, or the "addition of vectors," must be rejected when one is dealing with the velocity of light. Furthermore, the Minkowski-Einstein doctrine helps us beware of false identifications by impressing upon us that *every fact of nature is a space-time fact*. Just as space and time cannot be separated, so "mind" and "matter," "function" and "structure," and "thought" and "emotion" are inseparable.

When we are "conscious of abstracting" and refuse to identify the "individuals" of different "levels of abstraction," we avoid the danger of confusion of meaning of multi-ordinal terms, or terms with different meanings in different contexts. Only a correct symbolism—names with subscripts indicating dates—representing the precise level of abstraction can prevent false identification. Such a symbolism alone makes possible a truly extensional orientation, where there is a unique symbol for each unique, non-recurring fact in space-time. It may appear paradoxical, but it is an interesting fact that Aristotelian logic, which insists upon respect for the "law of identity," is itself unable to live up to its own requirement, since, in order to semantically correlate *single values* of terms with the entities symbolized, we need an extensional, infinite-valued orientation, rather than the two-valued orientation permitted by Aristotelian logic.

It is highly essential to realize that Korzybski does not deny that on the same level of abstraction (or in what the older logics termed the same "universe of discourse") words should retain constant meanings, that is, the same term should have the same "referent." This principle of symbolic univalence is essential. This, however, does not contradict the statement that identification as an orientation leads to disaster. The beginnings of animal intelligence are associated with identification, but in man this principle must be replaced by the recognition of the fact of non-identity, *for we now see that non-identity is as much a "law" of nature as the "law" of gravitation.* Man must learn not to "ape" or "copy" the reactions of lower animals.

As an example of the difficulties created by an elementalistic conception, consider the problem presented by the wave-particle opposition in our list of "contradictions." We *define* the properties of a wave (mathematically it is a function of the space and time variables, illustrating the equation of harmonic motion);

we also *define* the properties of a particle. The definitions are mutually exclusive. Then, looking to the physical counterparts of these definitions, we discover empirical evidence indicating that there is an overlapping of properties (definitions). Thus we have the problem of trying to think through a "contradictory" situation arising from the use of mutually exclusive definitions. What really exists in this case is the sun and the earth (or more generally, a source and a sink of energy), dynamically unified into a whole which manifests itself as the radiation of light. We know nothing of what happens between the two termini, although a particle or a wave theory of light will interpolate intermediate events between the source and the sink. Whether light would radiate from a source, if there were no sink to receive it, we do not know. It is entirely possible that light is really an expression of a wholeness-situation, which is not reducible to elementalistic terms. The need for non-elementalistic ideas in understanding the situation has already been pointed out in one form in connection with the thesis of relativity concerning the non-additive character of the velocity of light. It is certain that this fact of non-elementalism will ultimately turn out to be significant for the solution of the current problems of causality, induction, uniformity, and the like, previously mentioned. For the present, however, let us be content to establish the point that the *space-time continuum is the physical basis of organism-as-a-whole phenomena.*

The need for non-elementalistic, or organism-as-a-whole, views is readily demonstrated in the biological sciences, as already noted, but that physical situations also illustrate such non-additive relations has not been generally recognized. We need to realize once and for all that nature transcends our intellectual abstractions, in the sense that nature contains more than the scientific law or equation expresses. Every whole is a relative whole, contains subordinate parts, and in turn is contained within a larger whole. Each whole is something more than the parts into which it is analyzed, because analysis neglects the interstitial filling and wider context or environment within which each itemized fact or thing is situated. In the case of the wave-particle, or undulatory-corpuscular, opposition, nature does in fact contain both as relatively real types of phenomena, but analysis is unable to grasp in a single act of thought the wholeness in virtue of which both are real.

This fact that properties are not absolute, but are the result of abstraction within a context, is illustrated in our eighth antinomy, where we find that the properties of a chemical solution (whether it is electropositive or electronegative) are relative to the other term (solution) involved in the comparison. In general there is no such thing as the "same" event or object in different environments. For example, at any given time the "same" star may appear red from one point of view, and from another frame of reference may appear blue. Of course, the notion of the "same" time is ambiguous, a fact recognized in Einstein's relativity theory. This comment applies to any use of the idea of the "same" object, or two "identical" objects. All organic things—and even physics studies "organisms," as Dr. Whitehead says—when placed in different environmental settings express novel properties, as compared with the properties exhibited under previous conditions. For this reason the "law of identity" and the "law of excluded middle" do not apply to nature with absolute accuracy.

III. Conscious Gestalten and Brain Patterns

Now let us, in the remaining pages of this chapter, consider the psychology and brain physiology which underlies the theorizing leading us into the foregoing contradictions and difficulties of modern science.

One fundamental clue to the understanding of the present viewpoint is found in the concept of transcendence. The mind, no less than an organic complex, has the power of passing from the given, the thesis, to the antithesis, and then rising above both in a synthesis which transcends the opposition. In expounding the present view in terms of gestalt theory, the writer has pointed out that we can think of any entity *A* (the figure, cut out from the psychic continuum), but at that same time or psychological instant we cannot think of what is excluded, the non-*A*, or the ground of the conceptual gestalt. But the *A* is an abstraction from its own physical environment (ground), and is richer in its nature and possibilities than any "definition by fixation" of that entity recognizes. It is because a definition excludes as well as includes that we have difficulty in following the passage from *A* to non-*A*. Consciousness spans the disjunction because the "specious present" of the organism is trans-temporal. That this power of consciousness to transcend the figure-ground antithesis in a higher synthesis

has an appropriate neurological basis is the point I shall next attempt to demonstrate.

In the articles previously referred to, the suggestion was put forth that the functional complexity of reasoning rising to its most abstruse heights may have its basis in a physiological relativity of action currents. As we have already noted, electromotive forces and ionic concentrations are relative. And it is this biological (electrochemical) relativity which we believe underlies the figure-ground distinction and provides a possible explanation of the movement of thought through the union of opposites into higher intellectual syntheses. As consciousness moves on, uniting the past with the future, the intellect atomizes and breaks up wholes into parts. But throughout this movement there is also a correlative integration, and this points to the existence of some sort of binding forces which unify the parts. In other words, the intellectual transcendence in which the mind envisages the whole must itself be the expression of some unifying agent within the brain of the thinker as he seeks for intellectual unity. Thus as we reach out to the superior classes and larger generalizations within which each inferior part finds its context and meaning, there is a corresponding synergy behind the process. This view is not entirely footless, for there is physiological evidence indicating that this must be so. Here we can only refer to two converging lines of evidence.

Our thesis is that in every intellectual analysis the whole vaguely precedes the parts and dimly foreshadows the conclusion, even though it does not explicitly enter into the conscious analysis. Some evidence for this is provided by the work of Professor G. E. Coghill,[4] who states that in the development of reflexes the whole pattern precedes the parts, which are always differentiated out and articulated within the larger pattern If the physiology of brain development is similar to the development of reflexes (as gestalt theory and some of Lashley's results would lead us to expect), the whole pattern of brain-mind dynamics should help determine the elements into which our scientific constructions are analyzed out. That there is indeed a parallelism between the organismic development of conscious reactions and physiological patterns is pointed

[4] Cf. "The Genetic Interrelation of Instinctive Behavior and Reflexes," *Psychological Review*, 1930, Vol. 37, pp. 264–266.

out by Coghill[5] when he states that the basic principle in the development of the nervous system of vertebrates appears to be the maintenance of the total organismic system while independencies are growing up within that system. He states: "This fact, particularly should it be found to apply to mammals, must have important bearings on psychology and education. It is in harmony with the conception of 'mental configuration' as outlined by Koffka. According to this psychological interpretation, the first, or elementary 'phenomena' of consciousness are not pure sensations or independent, isolated units of reaction; they are 'qualities upon a ground' This, translated into anatomical and physiological terms, means that, as actually occurs in Amblystoma, behavior develops by individuation of elements within a primary unity, and not by integration of primary independent elements into a total pattern."

When, in the higher vertebrates, we try to find the specific neural basis of the differentiation of part-patterns within the larger wholes, we meet with difficulties. Professor C. J. Herrick has outlined some ideas on the possible physiological basis for the distinction between the "figure" and the "ground." He argues[6] that the diffuse and relatively equipotential neuropil provides the anatomical substratum for the unity of general behavior pattern, and elsewhere[7] affirms that "the 'ground' on which a particular 'configuration' of behavior is set has an anatomical organ in the brain, the relatively equipotential neuropil which pervades the brain substance and binds it together as a functional unit."

There is no question but that the "organismic theory of reasoning" must hold that the formation of ideas, concepts, etc., is a differentiation of part-patterns within larger wholes. On the side of logic the structures for such systems are known as "doctrinal functions" (C. J. Keyser) or "system functions" (H. M. Sheffer). The correlative idea that evolution is the phylogenetic counterpart of the self-transcendence evident in thinking would lead us to the conclusion that in both biological (phylogenetic)

[5] "The Growth of Functional Neurones and Its Relation to the Development of Behavior," *Proceedings of the American Philosophical Society*, 1926, Vol. 65, pp. 51–55.

[6] "Localization of Function in the Nervous System," *Proceedings of the Washington Academy of Science*, 1930, Vol. 16, pp. 643–650.

[7] "Anatomical Patterns and Behavior Patterns," *Physiological Zoology*, 1929, Vol. 2, pp. 439–448.

evolution and individual (ontogenetic) development, analysis (or differentiation of part-patterns) and synthesis (or integration) are mutually implicative. Logicians may break up the process of reasoning into inductive and deductive inference, but the present view holds that actual reasoning contains elements of both, and that these can be isolated from each other only through a process of abstraction. In connection with the movement of thought as a differentiation of part-patterns within an organism-as-a-whole situation, it needs to be realized that we never reach the final, all-inclusive whole toward which each inferior part points, *because mind is the behavioral process whereby the partial and incomplete moves toward completion.* In brief, "mind" is the functional process whereby the part-processes of brain-patterns are harmonized with each other, resolving conflicts and thus reconciling oppositions.

The fallaciousness of elementalistic conceptions in organic processes is readily illustrated by reference to brain physiology. Here let us refer to an earlier "contradiction" as embodied in the two previous propositions: "This cortical neurone is active," and "This (same) cortical neurone is inactive." Aristotelian logic, following the law of excluded middle, forces us to conclude that one of these propositions is false, since "contradictory" propositions cannot both be true. But we have already pointed out that there is no such thing as the "same" cortical neurone in different contexts. With reference to one brain-pattern this allegedly "identical" neurone may be active, and at the same time, with reference to another brain-pattern, it may be inactive. Professor S. H. Bartley informs me that while psychologists are not yet done talking about certain neurones doing this, and certain other neurones doing that, actual results indicate that the "same" nervous tissue may be both active and passive at the same time. Cerebral action currents are such only by virtue of a difference of potential at two points at a given time and whether you will get such a current depends on where one electrode is with respect to another on the brain.

These conclusions certainly lend plausibility to the theory of biological relativity and confirm the necessity for organism-as-a-whole conceptions. Moreover, the notion of the mind as the temporal-dynamic process whereby part-processes are harmonized with each other to form a new synthesis, probably throws some light on the situation which R. D. Carmichael summarizes in the

following words:[8] "There is room to doubt whether the mind can possibly be able to seize upon and understand and explain its own highest acts. If there is a hierarchy of powers in the mind then the higher might well comprehend the lower; but there would be no means left for comprehending the highest. A reasoned explanation of reasoning, to be complete, must also explain this explanation—and we seem forced to an infinite regression." From our own point of view the "highest acts" of the mind are the superior functional *Gestalten* arising out of previous organizations. In a sense the organism's responses to its own reactions *are* the mind. Mind, we repeat, is the process whereby the incomplete strives for completion, and it is this which animates and directs creative thought.

[8] Cf. *The Logic of Discovery*, 1930, pp 224–225.

CHAPTER FOUR

TYPES OF NON-ARISTOTELIAN LOGIC

Of all men, Aristotle is the one of whom his followers have worshipped his defects as well as his excellencies: which is what he himself never did to any man living or dead; indeed, he has been accused of the contrary fault.

—Augustus De Morgan

I. The Demand for Absolutes

One of the deep-seated cravings of the human mind seems to be a desire for something permanent, for something eternally the same, changeless and absolute. Of such an object of reverence it can then be exclaimed, "Oh, Thou Who Changest Not!" This worship of the changeless is by no means confined to religion, for in the field of philosophy, as is known, no less a person than Plato argued that change is a mark of imperfection. In science this demand for absolutes has manifested itself. In Newtonian physics, for example, "space," "time," and "matter" were conceived as absolutes. Following Newton, these concepts of physics, interpreted as things-in-themselves, became an integral part of classical mechanics and science generally.

In mathematics and logic the demand for something absolute has been no less insistent. This faith in the eternal certainty of something permanent was voiced by Lewis Carroll, that otherwise subtle critic of conventional habits of thought, when he stated that the charm of pure mathematics "lies chiefly in the absolute certainty of its results: for it is what, beyond all mental treasure, the human intellect craves for. Let us be sure of something!" More recently, in commenting on the fact of the disappearance of absolutes from natural science, a mathematician exclaimed: "Thank God, mathematicians still have the law of contradiction!"

This unwillingness to surrender the belief in something per-

manent and unchanging, abiding amidst universal flux, may by some be regarded as an example of human conservatism. Very few thinkers have sought to escape from this habit, or to nullify its desire. Logic, like mathematics, dealing with the supposedly permanent and necessary *forms* of thinking, has also—at least until very recently—shown a strong inclination toward this form of intellectual conservatism. This conservatism was illustrated by the demand that logic search out those universal and invariant validating forms of inference which the human mind must employ if it is to think correctly. These forms may then be given concrete interpretations in the separate disciplines (sciences) in which these logical forms may be employed. According to traditional logic, the most fundamental regulatory forms are the so-called "laws of thought," presupposed in all valid thinking, whether deductive or inductive. The specific recognition of these principles is generally credited to Aristotle, and the acceptance of them is a part of the Aristotelian tradition in logic. It is for this reason that any abandonment of the three laws of thought would constitute a non-Aristotelian logic.

And now let us state the laws of thought, which we have previously referred to only incidentally. They are as follows: (1) the law of identity; (2) the law of contradiction (sometimes called *non-contradiction*); (3) the law of excluded middle. As Professor C. I. Lewis states:[1] "From Aristotle down, the laws of logic have been regarded as fixed and archetypal; and as such they admit of no conceivable alternatives. Often they have been attributed to the structure of the universe or to the nature of human reason; and in general they have been regarded as providing an Archimedean fixed point in the realm of thought." So deeply rooted is this tradition that any challenge to the view is likely to be looked upon as foolish, and if by any chance such an attack should prove successful, this would appear to some logicians and mathematicians to mark the downfall of science and intellectual system. As one person has said, "to talk about non-Aristotelian logic is like talking about illogical logic—a contradiction in terms." Of course the extent to which various systems of philosophy have made use of the laws of thought has varied, but the extreme instance of the attempt to base a metaphysics on a logic is seen in

[1] "Alternative Logics," *Monist*, Oct., 1932.

the case of Fichte, who attempted to deduce an entire philosophy from the law of identity.

II. Non-Aristotelian Logics

Until modern times the possibility of a non-Aristotelian logic was not taken seriously. But so deeply has the virus of skepticism penetrated into the body of modern thought that the thing which our ancestors never considered as a possibility now is occurring. Today the last citadel of absolutism is being attacked. The three laws of thought mark the final battle line, and the fate of absolutism will be determined by the outcome. If the laws of thought should fall, then the most profound modification of human intellectual life will occur, compared to which the Copernican and Einsteinian revolutions are but sham battles. That famous river of Heraclitus, into which no man could step twice, then becomes a super-Protean flux into which one cannot step even once! A newer and more nearly universal relativity is appearing which threatens to abolish old landmarks, from which we have hitherto derived our intellectual bearings. But, you may be sure, before the fortress falls, there will be another decisive battle of the world. For, as Professor F. A. Lindemann says,[2] "the conventions and sanctions which bolstered up Euclidian space are as nothing to those which will be invoked to maintain inviolable the sanctity of logic."

The attacks upon the Aristotelian tradition come from several different sectors along the battle line, and have not come simultaneously. Different motives are at work in different cases. The sources of non-Aristotelian logic may be classified into three groups:

A. Evolutionary philosophy:
   1. Hegel's attack upon the law of excluded middle.
   2. The dynamic logic of some of the pragmatists.

B. Mathematics:
   1. Brouwer's criticisms from the point of view of the infinite.
   2. The substitution of a "many-valued" logic for the Aristotelian two-valued logic, by Lukasiewicz and Tarski, C. I. Lewis, and Zygmut Zawirski.

[2] In his essay on "Physics" in the co-operative volume, *The Mind*.

C. Physics:

Count Korzybski's attack upon the law of identity.

The common view of these laws of thought is that they are laws of *things* as well as laws of *thought*. To bring out this double reference, objective and subjective, I shall interpret the laws under two heads, ontological and epistemological; that is, as laws of physical reality and laws of mental operations. First, however, let us indicate how these laws are symbolized, respectively, in the logic of classes and the logic of propositions.

	Calculus of Classes	*Calculus of Propositions*
1. Law of Identity	$a < a$	$\vdash . p \supset p$
2. Law of Contradiction	$aa' = 0$	$\vdash . p \supset \sim(\sim p)$
3. Law of Excluded Middle	$a + a' = 1$	$\vdash . \sim p \vee p$

We consider the interpretations of these laws of thought in Table Three.

TABLE THREE

	As a Law of Reality	*As a Law of Thought*
Law of Identity	1. Whatever is, is. 2. A thing is what it is.	1. A word means what it means. 2. The meaning of a term must remain constant in any discourse.
Law of Contradiction	1. A thing is not what it is not. 2. Whatever does not exist is non-existent.	1. A word does not mean what it does not mean. 2. Two negatives make an affirmative.
Law of Excluded Middle	1. A thing either exists or it does not exist. 2. An existent thing has a certain property or it does not have it. 3. A thing cannot have contradictory properties.	1. A proposition is either true or false. 2. Two contradictory propositions cannot both be true. 3. A class (or term) is either included in another class, or it is not.

It will be noted that the law of excluded middle (L.E.M.) does not exclude the following possibilities:

(1) The same verbal proposition may be both true and false at the same time, but in different senses.

(2) The same proposition may, in the same sense, be true (or false) at one moment, and false (or true) at another.

We may not *know* which of two contradictory propositions *is* true at any given time, but one or the other necessarily is. Here is an example:

(*A*) Matter is infinitely divisible.

(*B*) Matter is not infinitely divisible.

These laws have been regarded as so fundamental that they have been used as tests of the very existence of propositions. Even Bertrand Russell has declared that a proposition is a statement that is either true or false, and if it is neither, it is nonsense. To illustrate: applying the law of excluded middle, "*A* is either *B* or not-*B*," one might ponder whether it is correct to say, "Virtue is either square or not-square." Traditional logic, accepting the law of excluded middle, would dispose of this statement by declaring that since this complex of words is neither true nor false, it is nonsense. So much by way of preliminary explanation of these laws; now let us glance at the history of their development.

III. From Aristotle to Brouwer

Aristotle apparently did not explicitly formulate the law of identity. It might, however, be regarded as implicitly contained in the following[3] statement: "Everything that is true must in every respect agree with itself." But Aristotle does definitely formulate the principles underlying the law of contradiction and the law of excluded middle. A statement of the law of excluded middle is found in the *Metaphysics*.[4] Here Aristotle argues that the most certain principle of all is that regarding which it is impossible to be mistaken. Such a principle is found in this, that "It is impossible that the same predicate can both belong and not belong to the same object at the same time, and in the same sense." In another place[5] he states: "If it is true to say that a thing is

[3] From Aristotle's *Analytica Priora*, 47*a*, 9.

[4] Bk. III, Ch. IV.

[5] *De Interpretatione*, 18*b*, 1–5.

white, it must necessarily be white; if the reverse proposition is true, it will of necessity not be white. Again, if it is white, the proposition stating that it was white was true; if it was not white, the proposition to the opposite effect was true. . . . It may therefore be argued that it is necessary that affirmations or denials must be either true or false."

And now let us consider the criticisms of these laws which have appeared in the years since Aristotle.

It would be difficult to state who was the first thinker to challenge any of the laws of thought, but it is possible that this doubtful honor belongs to Heraclitus, the evolutionist. In discussing the law of contradiction Aristotle says that "it is impossible for anyone to believe the same thing to be and not to be, *as some think Heraclitus says.*"[6] The first clear-cut case of the denial of a law of thought comes, however, in connection with an evolutionary viewpoint. Reference here is made to Hegel, whose denial of L.E.M., as we have already seen, is a part of his idealistic doctrine of change. For Hegel reality is process, a dynamic movement in which things grow, change, and pass away. Each thing passes beyond itself and becomes what it was not. A thing is a synthesis of opposites, an organic unity of differences. In this dialectical process thoughts, like things, start from (1) a *thesis*, and by an act of self-negation pass to the opposite pole of (2) the *antithesis*, from which the movement then passes into the union of the opposites, or (3) the *synthesis*. And so it follows for Hegel[7] that "contradiction is the moving principle of the world: and it is ridiculous to say that contradiction is unthinkable." Instead of speaking of the maxim of excluded middle (which is the maxim of abstract understanding) we should rather say: "Everything is opposite." In attacking this law, Hegel tries to show that *A* is both *A* and non-*A*, but critics have pointed out that Hegel sometimes confused contradictories with contraries.

Since for Hegel the logic of reality and the logic of thought are the same, the notion of the concrete universal is fundamental. H. Wildon Carr has maintained[8] that "it would be difficult to name a more perfect illustration of the concrete universal of Hegel than is offered to us by the modern electrical theory of matter." Carr

[6] *Metaphysics*, 1006*a*, 7. Italics mine.

[7] *The Logic of Hegel*, translated by W Wallace, 1892, p. 223.

[8] Cf. *A Theory of Monads*, p. 284.

here has in mind the concept of opposites kept apart and held together in a state of equilibrium in a field of force.

It is a curious fact that Hegel's system is at once one of the most obscure and most influential philosophies in all history. One needs only to recall here the influence of the Hegelian dialectic upon the development of the dialectical materialism of Karl Marx to see how apparently innocent philosophical ideas may assume momentous practical importance. But whatever the metaphysical and social effects of Hegelianism may have been, Hegel's criticisms of the laws of thought failed to bear fruit. Bosanquet's interpretation of Hegel's notion of the concrete universal in terms of the principle of identity-in-difference[9] is perhaps the outstanding example of the historical influence of Hegel's logic, at least until the present time.[10] Modern opponents of the law of identity will need to consider carefully this principle before they abandon the law of identity in favor of a relativistic-evolutionary view, for the law of identity, interpreted in terms of the principle of identity-in-difference, does not exclude change. As Hegel would say, the concrete universal is not a self-identical thing, but a form realizing itself in a historically changing system of things.

And now we consider the next heretic who has questioned the logical necessity of one of the laws of thought. We refer here to the Dutch mathematician, L E. J. Brouwer.[11]

Brouwer does not deny that the L.E.M. applies to all processes of thought concerned with finite classes of objects. But just as we recognize that the ordinary rules of arithmetic do not hold when we are dealing with transfinite aggregates (for instance, the rule that the whole is greater than any of its parts does not

[9] Bernard Bosanquet, *Logic*, 1911, Vol. I, p. 26 and *passim*.

[10] An interesting reinterpretation of the Hegelian dialectic in terms of mathematical logic is given by J. B. Burke in his book, *The Emergence of Life*, 1931.

A follower of John Dewey, Dr. Boris Bogoslovsky, seeks to revise the laws of thought to take care of the dynamic aspect of nature, and in doing so pays his compliments to Hegelian logic.

Since this is the only place we discuss the pragmatic influence, the reference is to F. C. S. Schiller's criticisms of the laws of thought in his books *Logic for Use*, *passim*, and *Formal Logic*, Ch. X.

[11] The best exposition of Brouwer's view available in English is to be found in Max Black's *The Nature of Mathematics*. See also Arnold Dresden's paper, "Brouwer's Contribution to the Foundations of Mathematics," *Bulletin of the American Mathematical Society*, 1924, Vol. 30, pp. 30–41.

hold when we treat a line as a dense series, composed of an infinite number of points) so, Brouwer holds, the law of *tertium non datur* (L.E.M.) must be abandoned But first let us state the general thesis underlying this view.

Brouwer is known as an intuitionist in mathematics: only those things are accepted which can be recognized in consciousness as true. According to this view, in order that a proposition can be accepted either it must be known *a priori* to be true, or its truth must be capable of demonstration. But in the case of mathematical demonstrations involving an *infinite* sequence of operations, the truth of any such proposition which is asserted is neither *a priori* evident, nor capable of demonstration; it is not constructible (*Konstruirbar*). Thus the proof that a certain number exists may depend upon the use of an infinite construction, or unending mathematical induction. In such cases, whatever assertion may be made must be justified by proof, but such proof cannot be exhibited, since the consciousness of an infinite sequence is impossible. If such an intuitionistic view were applied in all cases, this would mean that Brouwer would not agree—for instance, that it is either raining or not raining—until he had looked to see! Since, in the realm of the transfinite, one cannot intuit, Brouwer refuses to believe that propositions, the truth or falsity of which are in question, are subject to the L E M. Mathematical intuitionism, holding that a thing exists in mathematics only after it has been constructed or exhibited, is thus unable to justify much of even ordinary mathematics.

The next step in the development of non-Aristotelian logic, as E. R. Hedrick has pointed out,[12] is to show that the abandonment of the L.E.M. is not necessarily tied up with Brouwer's intuitionism. In other words, one may admit that the L.E.M. is not a necessary part of logic or mathematics, whether one be an intuitionist or not.

This step was taken when some logician abandoned the thesis that propositions can have only two values—truth and falsity. All the traditional systems of logic are two-valued logics. The Boole-Schroeder algebra of logic is a two-valued logic; even the Russell-Whitehead system of mathematical logic, which claimed to free itself from the limitations of the Aristotelian system, is

[12] "Tendencies in the Logic of Mathematics," *Science*, 1933, Vol. 77, pp. 335–343.

two-valued, in the sense that propositions are considered to be either true or false, as noted above. The actual business of developing a logic in which this law is explicitly disregarded was carried through by two Polish investigators, Lukasiewicz[13] and Tarski, who developed a three-valued logic, with a trichotomy of implications, in terms of truth, falsity, and uncertainty. From this it is clear that if we define an Aristotelian logic as a two-valued logic, then any logic with more than two truth-values—three, four, or *n* values—may be termed a non-Aristotelian logic. In a recent book,[14] C. I. Lewis has developed a logic in terms of the conception of "strict implication," as against the "material implication" of the Whitehead-Russell treatment in *Principia Mathematica* Here Lewis expounds the notion of multiple truth-value systems. Lewis declares[15] that there are no "laws" of logic in the sense that there are laws of physics. This view, similar to Hilbert's theory of mathematics, rests on the thesis that deductive system is the manipulation of meaningless symbols according to arbitrarily selected rules of operation. As Lewis says,[16] the source of necessary truth is in definitions, arbitrarily assigned. "Thus the tautology of any law of logic is merely a case of the general principle that what is true by definition cannot conceivably be false: it merely explicates, or follows from, a meaning which has been assigned, and requires nothing in particular about the universe or the facts of nature. Thus any logical principle (and, in fact, any other truth which can be certified by logic alone) is tautological in the sense that it is an analytic proposition." If this view is correct, we must agree with Lewis[17] when he states that the L.E.M. is not "writ in the heavens," but rather "reflects our stubborn adherence to the simplest of all possible modes of division, and our predominant interest in concrete objects as opposed to abstract concepts." It is to be noted, however, that Zawirski has made an interesting application of multi-valued logic in physics (see Chapter VII).

[13] "Philosophische Bemerkungen zu mehrwertigen Systemen des Aussagenkalkuls," by J. Lukasiewicz and A. Tarski, *Comptes Rendus Soc. de Varsovie*, 1930, Vol. 23, III, pp. 51–77.

[14] *Symbolic Logic*, by C. I Lewis and C. H. Langford

[15] Lewis, *op. cit.*, p. 211.

[16] *Loc. cit.*

[17] *Monist*, Oct., 1932.

IV. Nature and the Laws of Thought

It must not be supposed from this that the defenders of the Aristotelian system are put to rout. Far from it! The reply may take several forms. In the first place, the Aristotelians may argue that the view is self-refuting, in the sense that anyone who denies the L.E.M. presupposes it; for if you say that the L.E.M. is not true, you are assuming that it is either true or not true. Or the following ingenious argument, a restatement of Aristotle, may be given: "If a proposition is neither true nor false, let us call it doubtful; but then if the Law of Excluded Middle be false, it need not be either doubtful or not doubtful, so that we shall have not merely three possibilities but four, that it is true, that it is false, that it is doubtful, and that it is neither true, false, nor doubtful. And so on *ad infinitum*."[18] If this is not sufficient to show the necessity for the L.E.M., it can then be pointed out that no matter how many-valued your logic may be, the L.E.M. is still observed in the sense that a given proposition either possesses one of these values or it does not. This principle appears to be similar to what Paul Weiss has termed the "law of excluded $n + 1$."[19]

And now we come to the last possible attack upon the laws of thought.

If one were to ask which of the three laws of thought is the most impregnable, the law of identity would probably be recommended for that position. And yet an attack has been made upon that law. In the main the doubt arises from unusual phenomena in physics. Thus, as we have previously noted, when modern physics states that light and electrons are both undulatory and corpuscular, it seems to violate the law of identity, according to which a wave is a wave and a corpuscle is a corpuscle, and never can the two be one. The indistinguishability of electrons in material aggregates also suggests that here the law of identity has no meaning. Aside from such difficulties, which have led some physicists to suppose that the fault of physics lies not so much in the stars and electrons as in ourselves, we have the proposal of Alfred Korzybski to develop a non-Aristotelian system of science in which the law of identity is conspicuous by its absence.

We shall now consider, in a general way, the possible criticisms

[18] Quoted from F. P. Ramsey's book, *The Foundations of Mathematics*, 1931, p. 66.

[19] "The Nature of Systems," *Monist*, 1929, Vol. 39, p. 283.

of the law of identity, interpreted first as a law of thought and then as a law of reality.

In accordance with the position previously stated, the view here presented is that the law of identity, as a "law" of thinking, is both capable of being violated and incapable of being violated—in different senses, however. The law of identity has two meanings: it asserts (1) that a word (or proposition) means what it means, and (2) that the meanings of our terms should remain constant in any given universe of discourse. In the first sense the law of identity is a descriptive law, and in the second sense it is a normative law, or a regulative principle. The law of identity is a descriptive law in the sense that *at any given time* only one meaning can be assigned to any specified term. This psychological impossibility of the simultaneous duplicity of meaning, as the writer has suggested,[20] may rest upon some such physiological principle as the impossibility of the simultaneous innervation of reciprocal neuro-muscular patterns. If the bodily process underlying the thought of *A* is in progress, the bodily process underlying the thought of non-*A* cannot also be in progress at that same time. In this sense it is true that for "normal" persons the law of identity is psychophysically incapable of being violated, though, to be sure, one might imagine that some sort of biological mutation (for instance, the addition of another supra-granular layer to the cortex) might make it possible to think of both *A* and non-*A* at the same time, or to assign two contradictory meanings simultaneously to the same term. Perhaps this simultaneous innervation of alternative (mutually exclusive) patterns, which ordinarily function reciprocally, may occur in dreams. (At least my friend Dr. Rashevsky informs me that in dreams he is both himself and not himself—someone else—simultaneously.)

Considering the law of identity as a law of thought, we must recognize that in the course of time it is possible for words to have several meanings. We have new experiences; the nervous system is constantly in flux; and so we change the meanings of our terms. If it is true that the organism is never exactly in the same state twice, it would seem to follow that we can never think exactly the same thought twice. In any case, the law of identity, incapable of violation at any given moment, is capable of violation when time does its work. Logic recognizes this, and permits us

[20] "Biological Relativity," *Journal of Philosophy*, 1931, Vol. 28, p. 7.

to redefine our terms as required; but then we must revise all we have said while using the redefined terms.

And now for the law of identity as a law of reality. The law states that (1) at any given time, and (2) from some selected point of view, a thing remains identical with itself *in all respects*. This does not exclude the possibility that a thing may, in the course of time, cease to be what it was and become what it is—something else. The precise point of transition at which *A* ceases to be *A* and becomes non-*A* involves a nice problem of definition. It is also true, as Professor Whitehead points out, that "nature at an instant" is an artifact, and that it requires time for even the simplest thing to "be itself." Again, as Count Korzybski has noted, difficulties arise when we say that a thing is identical with itself in *all* respects, especially if "all" means an indefinite number of respects. Moreover, it is also true that a thing is what it is because of the environment it is in, and that *A*—an electron or an organism—may behave in one way in one environment, and in another way in some other environment. Thus a human being, functioning "normally" in an environment of normal temperature, air pressure, oxygen concentration, light, etc., will become quite "abnormal" if any or all of these are changed. This means, as we have already pointed out, that unless we are prepared to state all the properties a thing possesses, potentially and actually, in all possible environments, we can never tell what a thing is "in itself."

The final difficulty in applying the law of identity arises in connection with the circumstance that a thing, for instance, a star, viewed from one "frame of reference" may appear to possess certain properties (appear "red," for example), while viewed from another co-ordinate system it may "appear" to possess other properties (appear "blue," in the case of the star). The world *as we know it* is subject to (1) a relativity due to the physical motion of the system from which observations are made; (2) a relativity due to the biological constitution of the perceiving organism; (3) a relativity due to the psychological or mental set ("apperceptive synthesis") of the organism; and (4) a relativity due to the cultural status of the society of the observer. Only in the case of ourselves are we permitted, through introspection, to view a thing from its "own" point of view. In a sense a brain can "know" itself from its own point of view, but a star presumably can never know what it is in itself. According to the law of identity, a

star is a star and a hydrogen atom is a hydrogen atom, but what these things are in themselves we can never know fully and absolutely. And in so far as we do know these things, it is in terms of the brain which mirrors these things in the universe of consciousness. We see, therefore, that we can know an object only in terms of what it appears to be to us, in the given environment of a certain organism living at some definite time in a certain "cosmic epoch."

The conclusion of all this is that the "law of identity" as a law of physical reality occupies the same status as the equally famous principle of the "uniformity of nature" As "laws" of reality, both are incapable of being proved, and any attempt at empirical verification begs the question, or presupposes the point to be proved. But as a law of thought, it seems to me that the law of identity should be accepted as a normative principle. Indeed, in one sense it is inescapable, that is, in connection with what H. M. Sheffer terms the "logocentric predicament." We are reasoning about logic, and in doing so we are employing logic, and the logic we employ cannot be subject to criticism by itself. If we reason about "identity" and "non-identity," we must assume that the meanings of these terms remain "identical" as we continue to reason. In this sense the law of identity is a presupposition of all reasoning. But as we have already noted, it would have been better if this principle of the constancy of meaning in any given "universe of discourse" had been differently named, *viz.*, the principle of symbolic univalence, thus removing at one stroke the ambiguity which has always resided in this "law." So much mischief has already been done that it will doubtless take many years to disentangle the metaphysical and ontological implications and applications from the purely symbolic reference and use of this principle.

Up to this point we have discussed the several different varieties of non-Aristotelian logic, without attempting to state or criticize the one non-Aristotelian system which has thus far been worked out in the greatest detail. Count Korzybski's views have been referred to here and there, and we have at certain points made use of some of his ideas. Now it remains to examine at more length this particular system, and this we do in the next chapter. Following that, we shall in a similar manner state and criticize the non-Aristotelian scheme which Kurt Lewin has advanced under the title of the Galilean mode of reasoning.

CHAPTER FIVE

MODERN SCIENCE AND NON-ARISTOTELIAN LOGIC

There is a close parallelism between the confusion existing with reference to the fundamental concepts of science, physical and mathematical, and the confusion about purposes and values characteristic of modern life, socially and morally. As the former confusion has been brought about by means of the findings of recent physical science, especially the doctrines of relativity and quanta, so the confusions in social and moral life are mainly traceable to the impact of science, through invention and technology, upon social activities, old institutions and traditional mores.

—John Dewey

I. Intellectual and Social Unrest

Today the world is confronted by problems such as no age or race of men has ever faced before. There is not only a demand for a thoroughgoing reconstruction of the social order, but also a need for a revision of the theoretical foundations of science. A searching investigation would probably reveal that these two developments are not isolated manifestations, but only different aspects of the same unitary phenomenon—the demand for a new mode of orientation.

The statement that we need a new mode of orientation to deal with the practical and theoretical difficulties which confront us is more radical than some might suppose. We are here referring not merely to the content of our "thoughts," but to the very forms themselves. So fundamental is this proposed reconstruction that it reaches down into a critical examination of the "logical" and linguistic tools we employ in our orientations. In other words, one of the reformations which is now being advocated as an essential part of the new methodology is that we develop a theory of coherence to take the place of the traditional Aristotelian logic and adopt a non-Aristotelian system, thereby rejecting the most fundamental laws of thought which have regulated our "reason-

ing'' processes, inductive as well as deductive. If such a proposed reconstruction of our orientational technique should succeed in establishing its claims, we would be in for an intellectual revolution which would alter the entire character of our culture. In his recent book, *The Search for Truth*, E. T. Bell states that Euclid hogtied mathematics and Aristotle handcuffed human thought. And just as Lobatchewsky in the nineteenth century emancipated mathematics from the idea of "truth" in geometry, so Bell holds that non-Aristotelian systems free man from slavery to traditional "laws of thought." In the one example of non-Aristotelian system we are here primarily concerned with (that of Alfred Korzybski), Aristotelian logic, Euclidian geometry, and Newtonian physics are regarded as forming one coherent system, with non-Euclidian geometry, non-Newtonian (relativity) physics, and non-Aristotelian logic forming another coherent system.

As we have noted in the previous chapter, the demand for a non-Aristotelian system is not an isolated phenomenon. We now return to Korzybski's system, as presented in his treatise *Science and Sanity, An Introduction to Non-Aristotelian Systems and General Semantics*, because Count Korzybski has much to say about biological and psychological phenomena which is of interest to humanists.

In expounding the views of Korzybski, the first observation we make is that the focal point of attack of this system is against "identity." The most fundamental of the three traditional "laws of thought," implicitly assumed in Aristotelian logic, is that a thing is what it is, or is identical with itself in all respects. On the basis of this "law" traditional thought has argued that the human mind, observing these "identities" in nature, can generalize the observed uniformities and make statements about classes of objects, and these constitute the "laws of nature." Thus western European science was tied up with a logic developed by ancient Greek thought.

This schematism, as Korzybski points out, was elaborated long before the theory of relativity. Now the Minkowski-Einstein doctrine teaches us that a physical thing is a space-time fact, and that the temporal dimension cannot be separated from the spatial co-ordinates. For this reason the statement that an electron, or an apple, or anything, is "identical" with itself is false to facts, since there is no such thing as an identical piece of matter at

successive times. No object ever occupies the "same" space-time twice. Human beings, by virtue of their power of abstraction, can isolate "things" from their "environments" and label these supposedly self-identical objects with names; but we must not let language mislead us into believing that because we use the "same" name for an object, it is therefore the "same" object. Every object is unique, and should have a unique symbol. To avoid the fallacy of false identification, Korzybski states, we should label all our names with subscripts indicating dates, thus—$apple_1$, $apple_2$, etc. Any given object is a complex of sub-microscopic events in space-time, which can be treated as an "object" or "substance" when its behavior remains invariant in any given situation; but no two macroscopic objects are alike in "all" respects, and the "same" object is not identical with itself at some previous instant of time. Since it is language which misleads us into making these false identifications, it is necessary to consider in more detail the relation between language and thought.

II. Language and Thought

It is quite generally recognized that in primitive thought word-magic is an essential part of the "culture-pattern."[1] The conception of an occult connection between "words" and "things" leads to taboos against the use of certain sacred words and to such practices as giving evil names to dolls representing your enemies, on the assumption that the original of the manikin will thereby be injured. But that this verbal magic also crept into the culture of western Europe, largely through the influence of Greek philosophy, is not so generally admitted. And yet this fact is not difficult to establish. The momentous consequences of this fact will appear later, though we have already suggested some of the consequences in earlier chapters.

That some of the Greeks regarded words as the revelation of the nature of things is familiar to all students of ancient Greek philosophy. This is true, for example, of Heraclitus. For as F. M. Cornford states[2] of his philosophy: "The Logos is revealed in speech. The structure of man's speech reflects the structure of the world; more, it is an embodiment or representation of it." This

[1] On this point see *The Meaning of Meaning*, by C. K. Ogden and I. A. Richards, 1923, Ch. II.

[2] Cf. *From Religion to Philosophy*, p. 45.

Logos doctrine, interpreted in terms of the creative power of sound, entered into Christian theology through the Gospel of St. John, as scholars know.

This fact itself is of great historical importance in the subsequent history of western European culture, but when we take into consideration the interplay of thought and language in Aristotelian logic, and the tremendous influence of the Aristotelian tradition, the significance of word-magic in our own civilization becomes more obvious. This is a strong statement, and it becomes all the more impressive if we grant the validity of the contention of Bertrand Russell, who on several occasions has declared that he doubts whether anyone trained in Aristotelian logic could ever free himself sufficiently from that tradition to think clearly. Russell's view that the civilization of western Europe has been corrupted by its slavishness to Aristotelian habits of thought rests in part on his theory of the tyranny of language. In his book *The Analysis of Mind*, Russell argues[3] that many philosophers have erred in assuming that the structure of sentences corresponds to the structure of facts. He here refers to the doctrine of Sayce, who maintained that all European philosophy since Aristotle had been dominated by the fact that all philosophers spoke Indo-European languages, and therefore supposed that the world, like the sentences they used, was necessarily divisible into subjects and predicates. This theory of the relation of thought to language is entirely consistent with the statement of Mauthner that "if Aristotle had spoken Chinese or Dacotan, he would have had to adopt an entirely different logic." The fact is, however, that Aristotle did *not* speak these languages, and so we find that, for better or for worse, Greek language and logic formed the backbone of Western science and philosophy.

To see how this came about, it is necessary to make a brief excursion into the "theory of knowledge."

III. The Problem of Permanence and Change

One of the most obvious things about the universe is that it is constantly suffering change, but that in the midst of change there are foci of permanence. To explain this problem of change it has been the tendency of Greek thought to postulate some underlying substratum as the seat of the qualitative changes, which are then

[3] P. 212.

regarded as manifestations of this primal stuff. One of the earliest problems of the nature philosophers was to describe the nature of this original "stuff." The formulation of the view that qualities inhere in a thing-like core, as pins stick in a pin cushion, is generally credited to Aristotle. In favor of this view it may be noted that the categories of "substance" and "quality" first appear explicitly in the system of Aristotle, who is therefore held responsible for fixing in human thought the notion of the "thing" as the bearer of the qualities which inhere in this "substantial" substratum.

We have already seen that this metaphysics of matter is a consequence of the Aristotelian logic of classes. The foundation of Aristotelian logic is the doctrine that every proposition must affirm or deny a predicate of a subject. Since Aristotle's definition of primary substance is that which can be a subject but never a predicate, propositions about subjects must predicate qualities of the substances. In other words, in propositions the subjects are represented by class names, and in a logic of classes the predicates are the ascriptions to, or the denials of, a quality or attribute to the subject terms. One aspect of this logic which is especially noteworthy is the way in which the verb "to be" functions in expressing the various relations between subjects and predicates. The relations of "class inclusion," "identity," and "class membership" are regarded in modern symbolic logic as distinct in nature, and therefore as requiring distinct symbolization; but in Aristotelian logic they are lumped together under the common form of "*A* is *B*." According to Bertrand Russell, the use of "is" to express both predication and identity is a disgrace to the human race!

To be sure, there *is* room for difference of opinion on the matter of just what Aristotle meant by "substance." Among those who take the stand that the faulty Aristotelian conception of substance is intimately connected with the Aristotelian logic of classes is Professor A. N. Whitehead. As Professor Whitehead[4] says: "Aristotle asked the fundamental question, What do we mean by

[4] Cf. *The Concept of Nature*, 1920, pp. 18–20. Professor Whitehead repeats his criticism of Aristotelian logic in his more recent book, *Adventures of Ideas*, 1933, p. 196. Perhaps it is due to the influence of Whitehead's teaching that Charles Hartshorne describes Aristotle's notion of substance as "meaningless" (cf. "Metaphysics for Positivists," *Philosophy of Science*, 1935, Vol. II, p. 287).

'substance'? Here the reaction between his philosophy and his logic worked unfortunately. In his logic, the fundamental type of affirmative proposition is the attribution of a predicate to a subject. Accordingly, amid the many current uses of the term 'substance' which he analyzes, he emphasizes its meaning as 'the ultimate substratum which is no longer predicated of anything else.'

"The unquestioned acceptance of the Aristotelian logic has led to an ingrained tendency to postulate a substratum for whatever is disclosed in sense-awareness, namely, to look below what we are aware of for the substance in the sense of the 'concrete thing.' This is the origin of the modern scientific concept of matter and ether, namely they are the outcome of this insistent habit of postulation." This criticism of the Aristotelian notion of substance as a thing-like core was anticipated by E. G. Spaulding,[5] who also regards it as a consequence of Aristotle's logic. In justice to the situation, however, it needs to be kept in mind that there *are* those who hold that this is not an adequate interpretation of Aristotle. Thus, in connection with Professor Whitehead's views, J. D. Mabbott[6] argues that Whitehead has misunderstood Aristotle. Mr. Mabbott holds that while Professor Whitehead claims to be attacking the notion of substance as it comes down to us from Aristotle, he really accepts the Aristotelian conception of substance and is attacking the notion of a permanent independent physical object as it comes to us from the Greek atomists. Somewhat along the same lines, we find that Professor J. A. Leighton has protested[7] against the misinterpretation of Aristotle as embodied in Spaulding's views.

Whatever its origin, this substance-quality view has influenced all subsequent philosophy and science. One needs only to note that it is the metaphysical basis of the religious doctrine of transubstantiation to see the importance of this idea in Western thought—an importance which was not nullified until, as V. F. Lenzen points out,[8] relativity physics, through the electrodynamic conception of matter, eliminated the last vestige of Scholasticism from physics. Perhaps, also, the contempt for matter

[5] Cf. *The New Rationalism*, 1918, pp. 29-35.

[6] In his article on "Substance," *Philosophy*, 1935, Vol. X, p. 188.

[7] Cf. *Man and the Cosmos*, 1922, p. 187.

[8] See his article on "World Geometry," *Monist*, 1931, Vol. XLI, p. 501.

as a principle of evil (for instance, as in Puritanism and Christian Science) is to be sought in the turn which the Greeks gave to the problem of "being" and "becoming." Both in Plato and in Aristotle a dualism appears between the purposive activity of the "idea" or "form" and the resistance of matter. In science this notion of matter as a "retarding" principle reappears in the concept of "inertia." Here the consequence of Aristotelian physics was definitely unfortunate Aristotle's law of falling bodies, making velocity dependent upon mass, was false, and had to be corrected by Galileo. (It makes no difference to the argument whether Galileo established the new law by experiments from the Leaning Tower of Pisa, or whether this alleged historical event is a misinterpretation, as Lane Cooper states.) This substantialistic view of matter as the substratum of inertial mass—identified with the "primary qualities" of space-occupancy, impenetrability, etc.— exercised its authority in determining the theory of "space" as the vessel or *container* in which the motions of "matter" occurred; of "time" as the history of the transformations of matter in space; of "force" as the active cause of the motions of matter; and of the "ether" as the underlying continuum of the interactions of the "bodies" of nature. It is only recently that we have sufficiently disengaged ourselves from this attitude to permit ourselves to ask whether a thing-like stuff represents the foundational reality, or whether events and relational structure are more fundamental. The subsequent history of physics, guided by the Newtonian conception of "space," "matter," "force," etc., as absolutes of nature, and the transformation of Newtonian mechanics into the additive-particle-picture of Laplace, is the story of the inevitable movement of thought toward the inescapable consequences of the materialistic theory. This story is so well known as to make its retelling here a work of supererogation.

This, in brief, is the story of the alliance between Aristotelian logic and classical physical science. Now modern science must undo the cumulative effects of two thousand years of tradition. Physics is the first of the contemporary sciences to demand a new orientation. Relativity (non-Newtonian) physics is moving toward a new system which requires a non-Aristotelian approach. The attack on the classical system was first directed against the traditional notion of "substance" as an absolute and self-identical

underpinning of the phenomenal world. *Events* (or space-time facts) are now regarded as primary in nature. "Particles" must be regarded as nodes of permanence, invariant within their contexts of contemporaneous change. Complex "matter" is an aggregate, a relatively stable equilibrium, of such foci of electrical density. "Substance" is only a kind of resting-place for thought, expressing an unwillingness to analyze further. Einstein's thesis concerning the equivalence of "matter" and "energy" destroys the materialistic philosophy of Newton and Laplace. The old Aristotelian, subject-predicate (substance) logic is gone, never to return.

This is the present situation in physics. But what are the implications of this logical-physical revolution for science in general? Here let us return to Korzybski's views.

IV. Non-Additive Relations and Organismic Processes

We have said that Korzybski has been the most thorough investigator thus far to trace out the consequences of these non-Aristotelian ideas in biology, psychology, etc. Indeed, one of the most interesting features of this writer's views is the manner in which they link up with other contemporary movements in science. Korzybski has much to say about organism-as-a-whole processes, and by this he apparently means what others express by *non-summative*, *gestalt*, or *emergent* properties and behavior. For Korzybski this type of process is an instance of phenomena represented mathematically by non-linear equations. Until Korzybski, no one—with the possible exception of W. Köhler—has stressed this connection between organismic processes and non-linearity.

Count Korzybski points out in his book[9] that the notion of organism-as-a-whole is central in biology, psychiatry, etc., and terms this general principle "non-elementalism," meaning by this that the organism is *not* a mere algebraic sum of its parts, but is more than that and must be treated as an integrated whole. Bodily changes are frequently non-additive; as, for example,[10] when the heart for any reason slows down the circulation, this may produce an accumulation of carbonic acid in the blood, which again increases the viscosity of the blood and so throws more

[9] *Op. cit.*, p. 188.
[10] *Ibid.*, p. 116.

work on the already weakened heart. In the same way the superposition of new neurological processes on the old ones is non-additive, for this may fundamentally alter the whole character of the organism.[11] "Thought" also represents the reaction of the organism-as-a-whole,[12] and like all associative connections may be a non-additive function. Similarly, fears are not additive or linear functions, but follow some more complex function of a higher degree.[13] In general, the typical functioning of the nervous system is connected with what Korzybski calls "time-binding," which is represented mathematically by an exponential function of time.

It is part of Korzybski's thesis that this same general situation appears in physics, and that the theory of relativity illustrates the principle of non-elementalism. He states[14] that only since Einstein have we come to see that the simplest and easiest-to-solve linear equations are not structurally adequate. These non-linear equations are more complex and difficult to handle, and are often solved by approximations; but it is no one's fault that the world does not happen to be an additive affair.[15] In relativity theory this appears when the ordinary theorem concerning the addition of vectors (or compounding of velocities) is rejected. The corresponding parallel between gestalt theory and relativity ideas was first pointed out by George Humphrey,[16] and the writer,[17] in commenting on the analogy, expressed doubts as to its value, but in the light of Korzybski's thesis this judgment needs to be revised.

[11] *Ibid.*, p. 356.

[12] *Ibid.*, p. 413.

[13] *Ibid.*, p. 527.

[14] *Ibid.*, p. 265.

[15] In a review of Korzybski's book in the *American Mathematical Monthly*, 1934, Vol. XLI, pp. 570–573, Professor E. T. Bell makes this interesting comment: "There is nothing sacrosanct about the linearity of certain differential equations (and hence the additivity of their solutions) that makes most of the mathematical physics as we know it a possibility; a more competent generation may find that linearity is a gratuitous concession to present mathematical disabilities. It has been conjectured (although possibly not in print) by Einstein that some of our failures to give a coherent (= 'semantic,' in Korzybski's sense) account of some physical phenomena may be rooted in the traditional demand for linearity."

[16] Cf. "The Theory of Einstein and the *Gestaltpsychologie*: A Parallel," *American Journal of Psychology*, 1924, Vol. 35, pp. 353–359.

[17] Cf. "Gestalt Psychology and the Philosophy of Nature," *Philosophical Review*, 1930, Vol. 39, pp. 556–572.

We have stated that Korzybski's claim to the development of a non-Aristotelian system rests upon the rejection of "identity." But it is true that Korzybski is also committed to the abandonment of the "law of excluded middle"; thus the two-valued "logic" which requires that a proposition must be either "true" or "false" is replaced by a multiple-valued system. Following the demonstration by Lukasiewicz and Tarski (discussed in the previous chapter) that a three-valued logic can be so formulated as to include "modality," Korzybski argues[18] that as an *n*-valued logic tends to infinity, it becomes the logic of probability. Evidently the same idea is intended by Hans Reichenbach[19] when he states that "a logic of probability takes the place of two-valued logic, for ordering scientific propositions."[20] Thus, since Korzybski's notion of what he terms "infinite-valued orientations" has points in common with this more general non-Aristotelian development, it is unfortunate that we must here pass over this phase of his system. Before leaving this matter, however, it needs to be pointed out that Korzybski's system should *not* be described as a non-Aristotelian "logic." All existent "logics," Korzybski argues, are elementalistic, in the sense that they claim to study the activity of "reason" or "thought" independently of "emotion," whereas in reality the separation of "intellect" *and* "emotion" is just as objectionable as the separation of "space" *and* "time," or "mind" *and* "body." The science of the adjustment of man to his environment is a psycho-logic, and this is based on a non-Aristotelian system rather than a logic.

It is because of the broad scope of its principles and applications that the system of Korzybski is of interest to natural scientists,

[18] *Op. cit.*, p. 461.

[19] Cf. *Philosophy of Science*, 1935, Vol. II, p. 125.

[20] In this connection it is interesting to recall that Aristotle himself (in *De Interpretatione*) questions the applicability of the law of excluded middle to statements about individual future events.

This whole question is very difficult, and the literature on the subject is growing. Eventually, of course, the whole issue of determinism and the interpretation of the Heisenberg "uncertainty principle" are involved. Here is some of the literature: "On the Application of Many-Valued Systems of Logic to Physics," by H. Margenau, *Philosophy of Science*, 1934, Vol. I, pp. 118–121; "On the Principle of Flexibility of Scientific Truth," by F. Zwicky, *Philosophy of Science*, 1935, pp. 353–358; "Are Some Propositions Neither True Nor False?" by C. A. Bayliss, *Philosophy of Science*, 1936, Vol. III, pp. 156–166; *The Theory of Logic*, by A. P. Ushenko, 1936, *passim*; *The Span of Life*, by W. M. Malisoff, 1937, *passim.*; and *Experience and Prediction*, by Hans Reichenbach, 1938.

psychiatrists, and educators. And this brings us to what might be called the pragmatic sanction of this system. Noting the fact that there is much false-to-facts "thinking," infantilism, and consequent maladjustment in the world, and noting that certain types of insanity are based upon false identifications, and that there are obvious analogies between the "thinking" of schizophrenics and the magic of primitive peoples, Korzybski concludes that if we abandon "identity" we shall at one stroke render impossible not only the type of disorientation we have in *in*sanity (delusions and false identifications), but also the *un*sanity of those who are functioning in accordance with Aristotelian habits of "thought." The practical need for a non-Aristotelian semantics rests upon the fact that many human problems grow out of linguistic abuses. Our difficulties of adjustment are *neuro*-semantic and *neuro*-linguistic. Only by retraining in an extensional orientation can we undo the evil effects of false identifications. The infinite-valued adjustments of Korzybski's system require a new canalization of energy. This is a laborious process, but the end justifies the means. The results, Korzybski states, are automatic, far-reaching, and entirely beneficial.

Having thus presented in a thumbnail sketch some of the more important features of Korzybski's system, and having suggested a few of its applications, we now turn to some of the criticisms of this interesting scheme.

V. A Critique on Non-Aristotelianism

In looking over some of the reviews of the book *Science and Sanity*, and in talking with interested parties, I find that some of the main reasons Korzybski's critics give for regarding his argument as unconvincing are as follows:

(1) It will be argued by some that the very fact of false identifications presupposes that there are also true identifications. Thus John Doe, a patient in a psychiatric institution, may be there because he suffers from the delusion that he is Napoleon; but this "false identification" would never have occurred had John Doe observed the "law of identity"—that John Doe is John Doe. Moreover, in order to observe this fact of personal identity, we need not be guilty of confusing the name of the man with the man himself.

(2) Again, it will be argued by some critics that Korzybski is

forced to employ the very principle he claims to eliminate from his system. This, it may be held, is illustrated in a number of ways: (*a*) The law of identity is presupposed in observing the principle that in any given "universe of discourse" the meanings of our terms (defined and undefined) are to remain constant. (*b*) The notion of isomorphic structures, which Korzybski cannot get along without, and which, as we have seen, is becoming increasingly useful in all natural science, is an instance of "identity" of logical structure. (*c*) Even though in nature we never discover true instances of "absolute identity in all respects," nevertheless we need the notion of identity in our thinking. Émile Meyerson, for example, has argued at great length that the formulation of scientific laws and theories involves the process of "identification." For Meyerson the "irrational" is simply that which defies such "identification."

In connection with Meyerson's thesis concerning "identification," let us be careful to note that if we take a mathematical equation as an example of an "identity," as Meyerson proposes, it turns out that the "equality" asserted between what is on the left and what is on the right side of the equality sign is by no means an "identity." Moreover, certain non-Aristotelian enthusiasts might argue, even in purely formal logic the meaning of, and necessity for, the notion of "identity" still remains to be established. The classical work in the field of mathematical logic is the *Principia Mathematica* of Whitehead and Russell. But no less an authority than F. P. Ramsey argues[21] that one serious defect in this monumental work is found in the treatment of "identity." Ramsey holds that the definition "does not define the meaning with which the symbol for identity is actually used." To escape the difficulties he suggests that we adopt the proposal of Wittgenstein[22] and eliminate the sign of identity, replacing it by the convention that different signs must have different meanings.

The foregoing argument might be put forth by some non-Aristotelians as final confirmation of the repeal of this famous "law" of traditional logic. But in reply the Aristotelian will argue that this is only another example of fools rushing in where angels fear to tread. To avoid grave mistakes, it is necessary to know pre-

[21] Cf. *The Foundations of Mathematics*, 1932, pp. 30–32.

[22] Cf. *Tractatus Logico-Philosophicus*, by Ludwig Wittgenstein, 1922, p. 139.

cisely what is being done in the above instance. The real fact is that Wittgenstein and Ramsey have never criticized the Aristotelian *principle* of identity. They are concerned with the *concept* of identity, and find fault with the Leibniz-Russell *definition* of identity as derived from the principle of the identity of indiscernibles, when interpreted as a convention stipulating unrestricted mutual substitutibility.

It will be recalled that Leibniz's principle of the identity of indiscernibles appeared legitimate to him because of the atomism of his system: the perfect individuality of the monad made it a completely closed entity through all eternity. Without accepting Leibniz's monadology, the modernized version of this principle has found it very useful in the logic of analogies, etc. Thus the identity of an object may be defined in terms of its properties, and *a* and *b* are identical if all the properties of *a* are properties of *b* and vice versa. In the *Principia Mathematica* a similar use is made of this principle when it is asserted that two classes are identical if the propositional functions from which they are derived are "equivalent." Unfortunately this definition of identity in terms of predicative functions makes it self-contradictory for two things to have all their elementary properties in common. As Max Black points out,[23] there is clearly some difficulty here, for, aside from the fact that to say two things are identical is merely a clumsy way of asserting that in reality there is only one thing, there is the additional difficulty due to the fact that it is not permissible in the logistic scheme to speak of *all* the properties which two things have in common. This last difficulty is met in the *Principia Mathematica* by the use of the *axiom of reducibility* (that is, to any characteristics of a higher order there are equivalent characteristics of a lower order), but unfortunately this axiom has created more problems than it has solved. Since, however, the difficulties in this situation are a result of treating "identity" as a propositional function of two arguments, these difficulties are by no means insuperable.

A somewhat parallel clarification of the "identity-problem" has been attempted by the logical positivists. Apparently in logical positivism, or empiricism, the "principle of identity" is of little or no use, since this school is committed to the belief that propositions about identity are propositions about the use of terms. The

[23] Cf. *The Nature of Mathematics*, 1934, pp. 70–71.

positivistic view that "identity" is not asserted of objects having independent existence, but is asserted only of the names of objects, is presented by Mr. A. J. Ayer in his book, *Language, Truth and Logic* (1936). Here he affirms[24] that "the philosopher . . . is not directly concerned with the physical properties of things. He is concerned only with the way in which we speak about them." In opposition to this doctrine the present view holds that the propositions of philosophy are not purely linguistic in character. The idea that philosophical assertions are not factual, and that the principle of verifiability applies only to scientific propositions, leads to the conclusion that if in a scientific proposition $object_1$ and $object_2$ are asserted to be identical, either no difference is verifiable or convenience justifies overlooking it. This does not conflict with our own view that "identity" is a *limit*, but it does conflict with our conception of the philosophy of science as a speculative synthesis of scientific truths, and it is this conception that makes it impossible for us to admit that philosophical propositions are concerned with language, or terms in use (tautologies) rather than extra-linguistic referents (real "objects" and "events"). From the present point of view philosophy consists of hypotheses in process of verification.

With respect to the positivistic claim of Rudolf Carnap, in his work on *The Logical Syntax of Language* (1937), that there is no ethics in logic, so that logical systems, by virtue of the principle of toleration, are free to choose any sets of principles, I can only repeat that this is an example of the Korzybskian fallacy of elementalism in psychology. Reason and emotion ("facts" and "values") must not be separated as sharply as logical empiricism demands. That "truth" is a "value" has already been argued by the author in *Humanistic Logic*, and we here repeat that there is an ethics connected with "good" logic.

With respect to the question of whether Korzybski has made good his case for the elimination of "identity" from science, it seems to me that the answer here will be determined in some measure by one's reaction to his claim that the notion of "levels of abstraction" renders unnecessary Bertrand Russell's theory of types. As we have already noted, this theory, plus the very troublesome "axiom of reducibility," was supposed to provide an escape from the fallacy of "illegitimate totalities" and the vicious-

[24] *Op. cit.*, p. 61.

circle paradoxes arising out of the use of "all." According to Korzybski, the vicious circle arises from identifying different orders of statements: statements about statements represent the results of new neurological processes, their content varies, so that multi-ordinal terms (like "class") have a unique meaning *only* in a given context, where the order of abstraction is definitely indicated. If, therefore, we observe the rule of non-confusion of orders of abstraction, abandon the unrestricted term "class" and the "is of identity," and accept the four-dimensional language of abstractions of *different* orders, with a temporal co-ordinate, the axiom of reducibility becomes superfluous. Thus argues Korzybski.

For my own part, I can only repeat that physical identity is really a limiting case of analogy, as two things or situations become more and more alike, and this ideal limit is an asymptotic goal which in fact is never actually attained. And so far as pure logic is concerned, we reiterate that it would be much better to term the "law of identity" the "principle of symbolic univalence," and thus avoid the ambiguity which has always resided in this "law." In justice to Korzybski, however, it should be remembered that he is little interested in "formal" logic. His system is really a psycho-logic, and is concerned with the harmful effects of identification as an orientation to nature Korzybski insists that *general semantics*, a psycho-logic of adjustment, is an experimental science—a study of word-fact relations rather than word-word relations—and as such it does not need the approval of philosophers. If this be the case, we should forego the ancient tragedy of arguing about questions which ought to be matters of observation. Moreover, it is also clear that however else we may react to Korzybski's views, we should not make the mistake of judging the new *system* by the conventions of an alternative *logic*.

And now, having stated and criticized the non-Aristotelian system of Korzybski, we pass on to a similar critique of the non-Aristotelian psychology of Kurt Lewin. Following this, we shall summarize this whole non-Aristotelian development.

CHAPTER SIX

ARISTOTELIAN, GALILEAN AND NON-ARISTOTELIAN MODES OF THOUGHT[1]

Reason is free to change its logic, as language to change its grammar.
—GEORGE SANTAYANA

It is common knowledge that the several special sciences were once inhabitants of the domain of philosophy and that psychology was one of the last of the offspring to leave its ancestral home. No doubt in certain respects psychology has benefited by its recent separation from philosophy; and yet psychology has certainly had to pay a price for its newly-won independence. The fact that psychology was thus cut off from its formerly more intimate contact with logic has been particularly detrimental to the progress of psychology in its role as an up-and-coming science.

The truth of this last statement may be illustrated in a number of ways. For one thing the separation of psychology and logic helps us to understand why the chapter on "Reason" in many current psychology texts is unenlightened and obsolete. Moreover, it also explains in part why psychologists have tended to ignore methodology in their system-building enterprises. Finally, the separation of logic and psychology throws light on the curious dissociation in the Behaviorist who shows great persistence and ingenuity in criticizing the reasoning of his opponents, but is unable to scrutinize his own logic. Of course it might be argued that the Behaviorist here is entirely consistent, since in terms of his own system an examination of his own logical ("conscious") processes is ruled out. However, if we disregard this as a mere verbal subterfuge, it does appear that anyone who has ever had intimate contact with logic over a period of years would never fail to realize that any explanation of thinking which the psychologist puts forth must be applicable to the theorist's own doctrines as instances of thought processes.

[1] The present chapter was first published in the *Psychological Review*, March, 1939.

Fortunately these conditions are now being corrected. In recent years we have seen evidence of a reconciliation between logic and psychology. This promised reunion arises in part out of the needs which have grown up within the field of psychology itself. Conflict between systems has suggested the advisability of an examination of the logical technique used in the construction of such systems. The return to a closer relation is due also to the influence of gestalt psychology, which, with its philosophical background, has brought theoretical considerations back into repute. To be sure, this tendency to examine methodological procedure is manifested throughout the entire domain of science, from physics to sociology, so that this present trend in psychology is not unique.

While in a general way the influence of gestalt theory is to be commended, it is my purpose here to argue that gestalt theory has not gone far enough in its examination of the role of logic in the construction of systems. The development I particularly have in mind is that presented by Kurt Lewin in his recent effort to put psychology on the right path through the application of the concepts and technique of topology. In his book, *The Principles of Topological Psychology* (1936), Professor Lewin presents the thesis that psychology is now at the point where physics was about three hundred years ago—at the time of Galileo and Newton—and that the next step in the evolution of the science of psychology will be taken when it enters upon its post-Galilean career. Part of the background of this thesis is provided by Lewin's contrast between what he describes as the earlier Aristotelian mode of thinking, which hitherto has controlled psychological theorizing, and the later Galilean mode of thinking, which psychologists should now apply in their explanations.

It is my understanding that in Lewin's view topology provides at least one way in which psychology may hopefully pursue its way toward the goal of Galilean systematization. This may be illustrated by one example. According to Lewin, one of the characteristics of the Aristotelian mode of thought is to search for the explanation of events in the individual as such, in some inner drive or emotion, whereas the Galilean view demands that we seek the "cause" of events no longer in the nature of a single and isolated object, but in the relationship between that object and its surroundings. Only in terms of the Aristotelian mode of

thinking does the question of whether "heredity" or "environment" is more important possess a meaning. Topological psychology rejects this problem, for it recognizes that behavior is always a function of a person in an environment, or $B = f(P, E)$. And here topological psychology introduces *field* concepts to unite organism and environment.

In commenting on this proposed advance in psychology, we here wish to propose that gestalt theory of this type needs to be even more radical in its critique of logical foundations. In the preceding chapters we discussed the possibility that non-Aristotelian developments in logic may eventually be of great significance for psychology. In this chapter the same idea is extended. The question we now raise is this: If psychology is now at the place which physics occupied at the time of Galileo and Newton, and if, as we know, Newtonian physics was succeeded by post-Newtonian physics, why may not psychology learn a lesson from physics and take a short cut, jumping directly into its post-Galilean stage? Indeed, we ask, *would not the more general development of a non-Aristotelian logic and science include and transcend the Galilean mode of explanation?* That such a more general attack would yield all the results already attained seems clear. For example, consider the case of the rejection by topological psychology of the organism-environment antithesis. This step has already been taken in logic through the attack upon and the rejection of the Aristotelian notion of "substance," which was intimately tied up with the Aristotelian subject-predicate logic. The inseparable connection between Aristotelian metaphysics and Aristotelian logic, and the way in which both have influenced the developments of science during the subsequent twenty-three hundred years of western European culture, are subjects which have not been sufficiently investigated, but we have argued that it would be quite possible to present a good case for the thesis that, following Aristotle, the entire theory of matter which has been at the bottom of all science since the time of the ancient Greeks is a consequence of the Aristotelian logic of classes. In favor of this view we have noted that the foundation of Aristotelian logic is the doctrine that every proposition must affirm or deny a predicate of a subject, and since Aristotle's definition of primary substance is that which can be a subject but never a predicate, properties of substances must be qualities predicated of subjects. In other words, in

propositions the subjects are represented by class names, and in a logic of classes the predicates are the ascriptions to, or denials of, qualities or attributes to the subject terms ("substances"). In the medieval realism of the Scholastics this inner core of things was known as the *substantia essentialis*.

This notion of the "thing" as the bearer of the qualities which inhere in a "substantial" substratum has influenced all our thinking. It underlies all traditional forms of physics and psychology, so that Newton's theory of matter, Descartes' theory of the interaction of soul and body, and J. B. Watson's behavioristic psychology have all paid tribute to this mode of explanation. Today we have the modern electrodynamic theory of matter, and this removes the last foundation stone of the substance-quality or subject-predicate logic, and has finally eliminated the last vestige of scholasticism from physics. Thus we free ourselves from the shackles of the past and prepare for further progress.

Now compare this advance beyond Aristotelianism with the parallel attainments of the Galilean mode of thinking as Professor Lewin has presented it. The non-Aristotelian rejects the philosophic and scientific consequences of Aristotelian logic by saying that the traditional explanations are guilty of the fallacy of the absolute individuality of the subject (substance). In Lewin's "dynamic theory of personality" there is a similar rejection of "absolutes," and the individual is treated in terms of an integration of stresses and shifting forces. But non-Aristotelian system goes further and insists that in an evolving world, organically interrelated, the Aristotelian "law of identity" (or principle of individuality) does not hold absolutely. From the "lowest" level of nature, the level of electrons and protons, to the "highest" level that we know, the level of human beings, everything is evolving and manifests whatever "properties" it "possesses" through its interactions with other "things" in its cosmic environment. An atomistic-elementalistic conception, stated in Aristotelian terms, is therefore inadequate.

An organismic conception, as opposed to an atomistic-elementalistic one, requires a non-Aristotelian logic not only because the relativity of the subjects of predication ("substances") invalidates the law of identity; such a view is also non-Aristotelian because it demands the rejection of the Aristotelian law of excluded middle (or the principle of *tertium non datur*). Lewin's principle that

$B = f(P, E)$ is accepted in the non-Aristotelian system, but we recognize that any statement at best only approximates absolute certainty as a limit. In non-Aristotelian logic the traditional two-valued judgments of "truth" and "falsity" are replaced by an n-valued logic of probability (modality). Truth becomes a limiting case of a multi-valued logic, which limit is never in fact attained, because "laws" and even "facts" are abstractions from the idealized situations which are asymptotically approached. In biological work, for example, no two records on the smoked drum of a kymograph are ever exactly alike; they are only more or less similar.

We have intimated that the earlier history of physical science should enable us to extrapolate the subsequent history of psychology as it passes from its Galilean to its post-Galilean phase—or what we term its non-Aristotelian stage. Now if physics is to be our guide, we may expect the future of psychology to exemplify the outlook of present-day relativity physics, in so far as this now represents a stabilized and acceptable doctrine. Here again, in *transposing* generalizations from one field to another, it becomes obvious that if gestalt theory were more alert to the possibilities of the non-Aristotelian developments, it might avoid some mistakes it may otherwise have to make One illustration of this must suffice.

The weakness of classical physics was its necessity for absolutes. Space, time, mass, force, etc., were hypostatized and made into things-in-themselves (absolutes), not only because of the influence of the subject-predicate logic, but because of the presuppositions of the anthropocentric and geocentric cosmology carried out over from Aristotle through Ptolemy into the views of Galileo and Newton. Today relativity physics has eliminated the privileged frame of physical science, and all the foregoing "absolutes" have been relativized. But gestalt psychology, freeing itself from some of these Aristotelian presuppositions, still preserves the uniqueness of a privileged frame of reference—no longer the fixed frame of the earth, or a *primum mobile*, or the ether of traditional physics, but the privileged frame of an observer who splits space and time in the good old Newtonian fashion, contrary to the teachings of contemporary non-Newtonian science. To see this let us return for a moment to Aristotle.

The place of the doctrine of forms in Aristotelian metaphysics

is well known, and it need not be emphasized that for Aristotle forms were absolute. Gestalt theory likewise seeks the principles underlying the realization of forms (*Gestalten*), though it aims to avoid the teleological implications of the Aristotelian cosmology. But in all frankness we ask: Is there much difference between the declaration in the geocentric cosmology of Aristotle that planets move around the earth in circles because the circle is the perfect geometrical figure and everything in nature strives for perfection, and the gestalt law of "*Prägnanz*" as symbolizing the realization of forms in nature? And is it not apparent that the "gestalters" here have ignored the teachings of relativity physics that "forms" are relative, so that—for instance—what is a straight line in one frame of reference is a curve in another, and a circle is (becomes) an ellipse when viewed from a frame moving at right angles to the "circle"? In brief, does not gestalt theory, which in seeking to assimilate life and nature (as Koffka says) renders lip service to physics as the most fundamental science, nullify its own program by ignoring present-day non-Newtonian physics through its virtual reintroduction of the "local" time of the privileged co-ordinate system of the psychological observer? Gestalt psychology starts from the ego-frame of the observer and proceeds to study the laws governing the formation of spatial and temporal wholes (*Gestalten*); but if we are to take our physicizing seriously,[2] seeking the isomorphic relations between phenomenal, physiological, and physical structures, should we not recognize that every *Gestalt* is a four-dimensional space-time organization? It may be that a psychology which attempts to assimilate life and nature will find it necessary to modify or supplement relativity theory in some way, for as Émile Meyerson has pointed out, the irreversibility of experienced time has no correlate in the symmetrical (reversible) space-time manifold of physical relativity. In our own view the idea of consciousness as a "new dimension" aims to take care of this difficulty.[3]

Up to this point our treatment has been largely negative, pointing out what, from our point of view, is wrong with the contemporary gestalt theory. In order to map out a positive program for the future which may embody the organismic (non-elementalis-

[2] It must be noted, however, that Lewin is not willing to commit his variety of psychology to the "physicalism" of the logical positivists.

[3] Cf. *Philosophy and the Concepts of Modern Science*, Ch. VIII. See also Ch. XV of this book.

tic and non-atomistic) conceptions here asserted to underlie the non-Aristotelian theory, it is necessary first of all to correct the incompleteness of Lewin's theory. This theory assumes that there are only two modes of thinking, but as we have stated in Chapter I, there are really three modes of orientation, or "semantic reaction," as Alfred Korzybski calls them. These three, we repeat, are as follows: (1) the pre-Aristotelian mode of orientation, as revealed by Lévy-Bruhl's studies of primitive mentality; (2) the Aristotelian mode of thinking; (3) the non-Aristotelian adjustment, including here the post-Aristotelian or Galilean type of thinking of Lewin. I call attention to the omission of the first type because the third type—as we have previously pointed out—seems to resemble in some respects a return to the first type of orientation to nature

In support of this unorthodox hypothesis recall that the common element of the Galilean mode of thinking, as Lewin describes it, and the non-Aristotelian system, which is the last of our three levels, consists in the fact that in both schemes the study of the behavior of any "part" and the explanation of the "facts" is to be sought not merely in and through the nature of the thing itself, but in the whole of which it is a part. For us, however, "wholes" and "parts" are to some extent relative, and we hold that future progress in science will probably reveal new types of interrelation between relatively individuated wholes. This makes it clear that the explanation of any part is to be found in the mutual influences of the other parts of the wider universe. Thus we agree with Dr. A. N. Whitehead that the entire cosmos constitutes the environment of each empirical thing; but since each part is an abstraction and only relatively individuated, we assert that the so-called "laws of thought" are only partially adequate to an understanding of nature.

In order to be specific, let us here cite several examples of this new mode of understanding. First, however, we restate the three modes of orientation in terms of the "axioms" on which they are based. On the first level, the pre-Aristotelian mode of adjustment of primitive man, the axiom is "Everything is everything else." "Animism" is the inevitable result of "mystical participation" in the sense that it does not distinguish between the self and the not-self. There are no sharp dichotomies in nature, because the "laws" of identity, contradiction, and excluded middle are not

observed. On the next level of mental-social evolution, that of Aristotelian logic, we get these sharp distinctions. Here the axiom is, "This is this," and "That is that," and "This is not that." But on the third level we return to the idea that everything is everything else, except that this non-Aristotelian principle is based on a deeper understanding of the unity and the interrelatedness of nature than was primitive man's outlook.

Now, in looking for instances of this new insight, we turn first of all to the fundamental science of physics. Here we have it on the authority of Sir Arthur Eddington[4] that wave mechanics provides one meeting point for relativity and quantum theory. We are told that the electron as such has no physical properties. If it were absolutely alone, nothing whatever could be said about it, Eddington affirms.[5] In present-day physics the most fundamental equation is the wave equation of an electron, which gives a relation between the size of the electron and the universe. That is, the wave equation describes the electron in relation to a physical comparison object, and for Eddington this is the universe as a whole—the Lemaître spherical universe. This, of course, is a further development of Einstein's relativity theory, in which mass appears as a manifestation of the curvature of space-time. It also turns out on this theory that the number of particles in the universe has not been decided by arbitrary choice, but is fixed by an inner necessity, represented by the "cosmical constant."[6] Thus one may find relations in nature which tell the behavior of the universe in terms of an electron, and to measure the mass of an electron one can make observations on the distance and velocity of the spiral nebulae. This, I submit, is really something new in thinking!

When, several years ago, the writer first presented the idea that modern physics requires a non-Aristotelian logic, because of the fact that the law of identity is rendered non-true by present quantum data (of the wave-particle opposition), several critics of the author vigorously objected. Specifically it was pointed out that P. A. M. Dirac's theory of radiation promises successfully to resolve the wave-particle difficulty in physics. But in my subsequent volume (*Philosophy and the Concepts of Modern Science*,

[4] Cf *New Pathways in Science*, 1935, p. 108.

[5] *Ibid.*, p. 225.

[6] *Ibid.*, p. 253.

Chapter III), I reaffirmed the original position and pointed out that even Dirac's theory does not completely abolish this troublesome problem. It is significant that in the last edition of Dirac's book, *The Principles of Quantum Mechanics* (1935), Dirac admits in conclusion that "It seems that some essentially new physical ideas are here needed." That something like a non-Aristotelian principle is creeping even into Dirac's theory appears in his interpretation of the principle of superposition, which affirms that between the states of an atomic system "there exists a peculiar relationship such that whenever the system is definitely in one state we can consider it as being partly in each of two or more other states. The original state must be regarded as result of a kind of *superposition* of two or more states, in a way that cannot be conceived on classical ideas."

On the system of Aristotelian logic the proposition, "This system is in one state," would be true (or false), and the contradictory proposition, "This system is in another state," would be false (or true). But if, with Dirac, we say that the "same" system is simultaneously in two different states, this appears to violate the laws of Aristotelian logic. Nevertheless, this is exactly the non-Aristotelian situation we previously noted when we say, for example, in neurology, that the two propositions, "This neurone is active," and "This neurone is inactive," are both true, since the evidence indicates that the "same" neural elements may be both active and passive at the "same" time. As we noted, the way in which such "paradoxes" are resolved lies in recognizing that the subject of predication is not absolute, but, like a chemical solution, may be both (either) electronegative and electropositive, according to the context (environment) it is in. Thus the rejection of the law of excluded middle is in this case tied up with our rejection of the fallacy of the absolute individuality of the subject. If we adopt the terminology of George H. Mead, we may say that the wave character by means of which the individuality of the particle dissolves into the "mist" of the indeterminate (of the "probability wave") is an expression of the "sociality" of the electron.[7]

[7] We have already noted in connection with Korzybski's views that the conception of "emergence" finds some support in the doctrine of relativity concerning the non-additive character of the velocity of light. This idea has received support of a somewhat different sort in the important conception of nature advanced by George H. Mead in his book *The Philosophy of the Present* (1932), especially in the chapter on "Emergence and Identity." Starting

Thus the modernized Hegelian conception of emergence through the conflict of opposites can be applied to all levels of nature, from the electrodynamic concept of matter to the dialectic of social development. It is unfortunate that dialectical materialism (Marxism) did not see the non-Aristotelian logic inherent in Hegel's philosophy and adopt it as a valuable instrument and ally.

With this general view as a background, one may then proceed to the task of rewriting the entire domain of science in terms of such principles of complementarity, mutuality, and relativity. Along these lines, for example, the present writer has started from the supposition that the human time sense is a function of the velocity constants of the chemical reactions in the brain (Hoagland, Reiser[8]), has added to this the idea of Dr. W. M. Malisoff that the velocity constants of chemical reactions are related to the earth's gravitational constant (field), and has ended up with the idea that possibly the human time sense is a function of the rate of expansion of our cosmos. Aside from such speculative matters, it is clear that such a way of viewing nature will eventually lead to a new theory of biological evolution—as we shall later see (Chapter XXI).

It is for these reasons that we claim that future results in science will call for and create a new, non-Aristotelian type of mentality. Thus humanity will eventually acquire even different "habits of thought." In connection with Dr. Carrel's book, *Man, The Unknown*, it is interesting to note that he suggests the need for a special and highly intensive training for the future scientific "brain trust" which is to undertake the work of intellectual synthesis. And in his book, *Earth, Radio and the Stars*, Dr. Harlan Stetson points out that the solution of the problems concerning the earth and its inhabitants in the cosmic scheme of things bids fair to introduce a new synthetic science which—as previously noted—he designates as "cosmecology," the business of which is to bring

---

with the thesis that temporal transition is itself a kind of relativity and that sociability is a capacity for being several things at once, due to the fact that the novel event is in both the old order and the new order which its advent heralds, Dr. Mead arrived at an original interpretation of physical relativity. Here the increase in mass, which on relativity theory accompanies the increase in velocity, is due to the fact that the "emergent" motion changes the physical character of its object, its mass. And just as emergent velocities change the character of masses, so in a similar way emergent life changes the character of the world.

[8] "The Chemistry of Time," and the references there cited, by Hudson Hoagland and O. L. Reiser, *Philosophy of Science*, 1934, Vol. I, p. 351.

together the results of all the sciences bearing upon man. In the present view we try to incorporate both lines of thought. We project the curve of biological and human social evolution, and look forward to the production of a type of superthought for the future race of thinkers for whom cosmecology will constitute a kind of kindergarten course in non-Aristotelian training.

Since the time of Charles Darwin, psychologists have paid lip service to evolution, but they seem never to have realized that evolution is not yet done with the human organism. Their picture of human nature was painted on too small a canvas. Both Aristotle and Darwin set the compass of human thought and marked out the boundaries of its explorations. But already we see the inadequacies of their picture of the human organism. Karl Marx was in a position to escape these limitations—but he missed his chance! A theory which goes beyond these great pioneers must of course build upon the foundations which they laid, but at the same time we must not forget that the mind of man cannot forever be tied to the immemorial past out of which it has emerged.

CHAPTER SEVEN

RÉSUMÉ: ARISTOTLE, NEWTON, AND EINSTEIN

I know not what the world may think of my labors, but to myself it seems that I have been but a child playing along the sea-shore; now finding some prettier pebble or more beautiful shell than my companions, while the unbounded ocean of truth lay undiscovered before me.

—Sir Isaac Newton

I. The Practical Values of the Aristotelian Forms

In the previous chapters we have argued that Aristotelian metaphysics and the derived science and philosophy of western European culture are intimately tied up with Aristotelian logic. We have sought to show that further progress implies another advance which will go beyond the Aristotelian formulation in a manner analogous to the way in which Aristotelian logic and science superseded the pre-Aristotelian "religion," "magic," and "philosophy" of primitive thought. In explaining the tremendous vogue of the prevailing Aristotelian modes of thought, we have also proposed that the great value of Aristotelianism is its psychological simplicity, the manner in which it lends itself to practical needs. And finally, because of the sheer force of habit and convenience, this two-valued logic of truth and falsity, of identity and non-identity, is still looked upon as the simplest and most convenient. Since no broad cultural transition ever occurred instantaneously, the habits of thought and speech which the logic of identity has served and fortified may be expected to survive in our culture for some considerable time to come. Thus we have analyzed the situation up to the present time.

That practical purposes do in fact enter into the selection of a logic is brought out in one way in the statement of H. C. Brown that "the noun enables us to select a region of reality in which we are interested, and the adjective the aspect of that region in which we are interested." This of course is only another way of recognizing the utility in adjustment of the subject-predicate (noun-

adjective) logic, for the adjective merely expresses that which can be predicated of a subject (for instance, "Snow is white"). The further supposition, stated in the words of Alan Gardiner, that "it may reasonably be doubted whether a serviceable grammar which dispenses with such terms as noun and verb will be written," is certainly open to question. In so far as this may be correct, it is so because, in operational-behavioristic terms, verbs usually represent "actions" performed upon "objects" (nouns).

And yet we must note that it is precisely this disjunction of "substance" and "action," the "thing" and its "behavior," which has created the present difficulties confronting science and philosophy. As Dr. Whitehead points out, all modern philosophy hinges upon the difficulty of describing the world in terms of subject and predicate, substance and quality. Only a non-Aristotelian logic, we have argued, can free us from the shackles of traditional verbal forms. The logic of *propositional functions*, supplemented by a *statistical theory of classes*, will eventually free us from the subject-predicate form of reasoning. There is no use lamenting the fact that the older verbal forms commit us to the forms and implications of a two-valued logic of identity. The remedy, difficult as it may be to introduce, is simply that we must give up the old language with its grammatical forms and mental habits. The correlative changes in modes of thinking and types of inference will eventually free us from hampering modes of reasoning.

Of course, before the physicists and other natural scientists will consider seriously the recasting of their problems and solutions in the mold of a new logic, they want to be certain that the logicians, those who presumably are the experts in the field, are convinced of the logical possibility and practical utility of such a logic. This we shall consider later, but before taking up that matter we must observe how the need for such a logical reformation had its adumbrations in the growing restlessness and uneasiness in philosophy, eventually to culminate in an outright rebellion against the tools which are no longer adequate to their task.

As we have already noted, philosophers here and there have struggled with and eventually protested against the subject-predicate logic. Philosophically the clear line of demarcation between substance and quality, the entity and its behavior, began to break down long ago. The attack on "substance" has a his-

tory. Thus quite early in modern thought, in Boscovich's *Theoria Philosophiae Naturalis*, atomic theory was being written in dynamical terms, and Kant also, in his *Metaphysische Anfangsgründe der Naturwissenschaft*, adopted the position that the very existence of space-filling body presupposes attraction and repulsion. In England, Berkeley's destructive criticisms of the inconsistent idea of "matter" made it possible for J. S. Mill to escape the tyranny of the idea of material "substance" by defining matter as the "permanent possibility of sensation." Still prior to the modern electrodynamic theory of matter of contemporary physics, Hegel was insisting upon the concept of the *thing* as the *law of its states*. More recently, the notion of matter was still further "dematerialized" when Karl Pearson defined matter as "non-matter in motion." Bergson gave these newer tendencies a peculiar twist in his conception, which we need not here expound and which we refer to only in order that we may indicate that those who opposed Bergson by asking the question, "How can there be motion if there is nothing which moves?" were still under the persistent influence of the substantialistic habit of thought engendered by Aristotelian logic. William James, a thinker sympathetic with Bergson at many points, declared his emancipation from the philosophy if not the logic of Aristotle when he advised philosophers to leave off grubbing underground in the realm of the transempirical to find out what makes substance substantial, or what makes action act. Finally, bringing this sketchy survey down to date, we have the culmination of this movement toward the dematerialization of matter and the substantialization of behavior in the views of Herman Weyl, when he refers to the substance-action of electricity, and the de Broglie-Schrödinger undulatory conception of material particles as foci of electrical density. This means philosophically that a thing *is* what it does, and, as previously pointed out, it also means that a thing *is* wherever its effects extend. Thus, from a behavioristic viewpoint, if light *behaves* like corpuscles and waves, it *is* both of these ("contradictory"—on the old logic of the principle of excluded middle) realities. Our own term, "behavior-stuff," was deliberately framed to cover this situation.

So much for the philosophical background of this development. Now let us look at the situation more from the point of view of the progress of physics.

II. Modern Physics and the Law of Identity

Until recently the problem of the logical possibility and the scientific utility of a non-Aristotelian system was not recognized as such; but current attempts at a generalization in the direction of non-Aristotelian system make it evident that, for better or for worse, we are going to hear much of this subject in the near future On the one hand there will be those who, like Professors Cohen and Nagel,[1] will assert that they do not believe in the possibility of a non-Aristotelian logic; but others, like Professors C. I. Lewis[2] and H. B. Smith,[3] will argue to the contrary and assert their belief in at least the theoretical possibility of a non-Aristotelian logic, whatever its practical value may be. In accordance with the general thesis of this second group, certain investigators like Korzybski will insist that the next great step in social evolution and the mental development of the race will consist in abandoning the older forms and accepting the newer non-Aristotelian mode of thought.

The issues involved in this problem are numerous and complex, and the outcome will undoubtedly be as important as anything can be which issues from the field of logic. To establish the validity of, and scientific necessity for, a non-Aristotelian logic, certain propositions will have to be established which at present certainly cannot be regarded as demonstrated to the satisfaction of all. It is my purpose here to consider several such propositions, and in the present chapter I shall seek to demonstrate the following thesis:

I. *The postulates and main characteristics of Newtonian physics are a necessary consequence of the postulates and main features of Aristotelian logic.*

If the validity of this thesis can be established, it is then appropriate to consider the validity of a second thesis, which may be stated as follows:

II. *The acceptance of a non-Newtonian physics calls for the acceptance of a non-Aristotelian logic.*

[1] Cf. *An Introduction to Logic and Scientific Method*, by Morris R. Cohen and Ernest Nagel, 1934, p. v.

[2] *Symbolic Logic*, by C. I. Lewis and C. H. Langford, 1932, p. x.

[3] Cf. *Philosophy of Science*, 1934, Vol. I, p. 489.

Since the burden of the present discussion is to establish the more difficult first thesis, I shall seek to demonstrate the second thesis first, and thus leave the greater portion of our time available for a consideration of the first proposition.

It is asserted that the second thesis is relatively easily established as a consequence of the first, because, by recognized processes of immediate inference, we can derive the second from the first. If we may regard the first thesis as an "identical proposition," we then get the following equivalences:

$$\text{Aristotelian Logic } (A) \rightleftarrows \text{Newtonian Physics } (N)$$

By immediate inference we have:

(1) $A < N$	original proposition	(1) $N < A$
(2) $A \nless N'$	obverse	(2) $N \nless A'$
(3) $N' \nless A$	converted obverse	(3) $A' \nless N$
(4) $N' < A'$	contrapositive	(4) $A' < N'$

That is:

$$\text{Non-Aristotelian Logic} \rightleftarrows \text{Non-Newtonian Physics}$$

A possible criticism of this process of immediate inference is that we are trying to deduce the necessity for non-Aristotelian logic by means of Aristotelian principles of immediate inference. This objection cannot be regarded as valid. It seems to assume that Aristotelian and non-Aristotelian logic are mutually exclusive and incompatible. But the fact is that non-Aristotelian logic is more general and includes Aristotelian logic as a special case. In Aristotelian logic, "equivalent" propositions are established through the use of the notions of "truth" and "falsity," and the processes of conversion and obversion employ the same ideas. The principle of Aristotelian logic which is here at issue is the "law of excluded middle," that a proposition is either true or false, but not both. However, if we take "truth" as one limiting case—that is, the case in which both non-Aristotelian and Aristotelian logic coincide—we can proceed to draw the necessary implications from the truth of the first thesis If we were trying to infer anything from the assertion of the non-truth of a proposition, it would be a valid question to ask whether the same implications follow on the Aristotelian assertion of only *one* other value (that is, falsity) as follow in the multiple-valued logic which

replaces the two-valued logic of Aristotle based on the principle of *tertium non datur* In brief, there is at one point no contradiction between Aristotelian and non-Aristotelian logic—the point at which the more general non-Aristotelian logic reduces to the special case of the less general Aristotelian logic. It must always be remembered that *non*-Aristotelian logic is not *anti*-Aristotelian logic!

Having thus shown that the second thesis is a necessary consequence of the first thesis, and having disposed of the objection which seeks to invalidate this derivation, we are now in a position to return to the first thesis.

We shall not here attempt to present in detail all the evidence that can be produced to demonstrate that classical or Newtonian physics did in fact rest upon the acceptance of the postulates of Aristotelian logic. Part of the difficulty of such an undertaking arises out of the fact that when we search for a statement of the postulates of classical physics, it soon becomes apparent that treatises on physical science do not explicitly state their fundamental assumptions. Moreover, the situation is complicated by the fact that since the time of Newton and Leibniz, various systems of pre-Einsteinian physics, differing from one another in certain more or less important respects, have been presented. Thus, to illustrate, the "energetics" of W. Ostwald does not presuppose the "particle picture" of Newtonian physics. The ideal proof of our first thesis would be a strict derivation of Newton's three laws of motion from the three laws of thought of Aristotelian logic, but it is not clear that this is feasible. However, in an investigation of a few years back[4] we suggested what appeared to be the fundamental presuppositions of what we have rather loosely termed classical physics, and also stated the reasons, in terms of the science of that year, for questioning these postulates ("axioms"). Several years later a more thorough investigation of this matter was undertaken, and the results were set forth in the volume *Philosophy and the Concepts of Modern Science* (Chapter III). Here and there, in this present work, additional reasons are given for this attitude (see especially Chapter XX).

These postulates we have referred to as basic to the presuppositions of classical physics have been reproduced in Chapter XX of the present book. We shall not here resummarize the reasoning

[4] See my paper, "Physics and the Laws of Thought," *Psyche*, 1931, Vol. 11, pp. 70–80.

we have already put forth to justify the claim that modern science now demands a non-Aristotelian logic to organize its facts and principles; rather let us try to get at the same conclusion by a different route. This is what we shall attempt in the next section.

III. Organismic Logic in Physics and Biology

According to the principles of conventional formal logic, the following postulates ("laws") hold for the manipulations of all symbols:

If, by the law of identity:

$$\triangle = \triangle, \text{ and } \square = \square, \text{ and } \bigcirc = \bigcirc \tag{1}$$

then, by the commutative law:

$$\triangle + \square + \bigcirc = \bigcirc + \triangle + \square \tag{2}$$

and:

$$\triangle \cdot \square \cdot \bigcirc = \square \cdot \bigcirc \cdot \triangle \tag{3}$$

But if these symbols refer to concrete "things" (that is, aggregates of behavior-stuff), then (2) does not hold, because if you add electrons and protons and radiation (a field) you get an atom. In that case the behavior of each entity is now a function of the properties of the non-additive (emergent) whole. Or if these three symbols represent musical notes (*c*, *e*, and *g*, for example), you get a musical chord. But for the same reason (the "chordiness" of a whole), the order in which the units are added is important, and in these cases the commutative law no longer holds. It is very significant that physicists are coming to recognize the importance of *wholes* in physics. To support this statement I quote at length the following passage from Herman Weyl's book, *The Open World*:[5]

The state of a physical system is determined when for each physical quantity of the system the probability of its taking on each possible value is known. It is true therefore that the state of a system consisting of two electrons determines the states of both electrons, but the converse does not follow. The knowledge of the states of the two parts of a system by no means fixes the state of the whole system. We find here a definite and far-reaching verification of the principle that the whole is more than

[5] 1932; p. 55.

the sum of its parts. Modern vitalism, among whose proponents I mention first of all Driesch, has attempted to reduce the independence of life, its essential distinction from non-organic processes, to the concepts of Gestalt or the Whole. According to vitalism the living organism reacts as a whole; its functions are non-additive. The manner in which its structure is preserved throughout growth, in spite of all outside influences and perturbations, is not to be explained by small scale causal reactions between the elementary parts of the organism. Now we see that according to quantum physics the same applies even to inorganic nature and is not peculiar to organic processes.

Some physicists may be displeased at this introduction of organismic conceptions into physics, but we, as philosophers, must not overlook the fact that this, at the same time, makes it easier for the biological sciences to apply physical notions in physiology and psychology.

This comment on the traditional rules of formal logic applies to all levels of integration and evolution in nature. If A and B are two macroscopic objects (vast assemblages of atoms) of the same "class," as for example two amebas, then traditional logic and science state:

$$A = B \text{ (these two amebas are identical)}$$

But since A and B are complex, this means that the sum of the constituent parts (let us arbitrarily limit ourselves to proteins) must also be identical, so that:

$$(a_1, a_2, a_3, \ldots, a_n) = (b_1, b_2, b_3, \ldots, b_n).$$

But chemistry in turn treats proteins as "classes" and assumes the same principle, so that:

$$a_1 = a_2, \text{ just as } b_1 = b_2.$$

This means that the protein molecules (a_1, etc.) of organism A are identical with the protein molecules (b_1, etc.) of organism B. If history did not play a role in determining the properties of all constituent organisms on all levels, we could treat them as "identical." And indeed the parts can be treated as identical—until they behave non-identically. This is seen in mutations in organisms and in the disintegration of radium atoms. What particular

"cells" of any family on any level will behave in a manner non-identical with those of its own brothers and sisters on that same level, is impossible to predict, but this non-identity of behavior must reflect some non-identity in history of the constituent parts. In the case of the disintegration of radium atoms, the explanation of the sudden "exploding" of any unit is perhaps to be found in an accumulation of "experiences" representing a summation of "hysteresis" (memory) effects. Statistically it is true that in an average interval of time a relatively constant number will explode, but which particular ones will do this cannot be predicted in advance, because we cannot follow the life histories of each of the component parts. Thus the assumption that if $A = B$, then $A_{t_1} - t_2 = B_{t_1} - t_2$, may be true for the statistical ensemble as a whole, but false for any given entity in that ensemble. Since, however, every complex organism is a sum of statistical units, and is itself a component part of a unit of a higher level, what we have said about each whole as being non-identical with other members of its own level holds for each "part," since—as we have emphasized—each "part" is a "whole" with respect to its own constituent elements. That is to say, starting with any lower level, the whole which organizes these parts is not identical with any other whole on its own level, because the "parts" of that whole are never identical in structure or behavior. There is, however, a statistical constancy of behavior, and it is this that makes possible the various sciences.

It is for this reason that we need a statistical theory of classes to represent the facts in the case. The "central tendency" of the class will incorporate those average properties which manifest themselves in "normal" environments, but *it must never be forgotten that identity is a relative matter:* relative to the history of the thing considered, relative to the environment the thing is in, relative to our own practical purposes, relative to the frame of reference from which it is viewed, etc., and it is in fact and in principle impossible to reproduce *all* the conditions and circumstances which the statement, "*A* is identical with *B*," would presuppose for verification.

Unless the reader continually keeps in mind that the present non-Aristotelian view is thoroughly evolutionary, from the top to the bottom of nature, and is thoroughly organismic, so that atoms no less than the most complex aggregates of atoms are

regarded as organically evolving beings whose properties progressively evolve and change as they interact with other such organisms, much of the force of the argument will be lost upon him. Zeno pointed out certain "paradoxes" of change, which he thought rendered change unintelligible and therefore unreal. Our contention is that this problem of change presents itself on all levels of evolution, and we hold that the same considerations that will solve the particle-wave opposition in nature (which is essentially the substance-action problem) will also clarify the general problem of progressive evolution.

In *Philosophy and the Concepts of Modern Science*, we have already struggled with this problem. Hegel "solved" the problem of change by admitting the contradictory element and by abandoning the principle of excluded middle as a "law" of nature. Bertrand Russell solves the problem of change and motion through the use of the modern mathematical concepts of "infinity" and "continuity." But, as we have already noted in connection with our statement of the views of L. E. J. Brouwer, the idea of the infinite which Russell employs introduces certain difficulties ("paradoxes"), and these Brouwer proposes to avoid by abandoning the law of excluded middle as applied to infinite aggregates. Thus both Hegel and Brouwer, for what are usually regarded as essentially different reasons, agree in their rejection of this Aristotelian principle. In our own view we try to bring the views of Hegel and Brouwer together. This we do by completely rejecting the Aristotelian-Newtonian conceptions of "space," "time," "matter," and "motion" as absolute and independent realities. "Motion" is not a "change" of a "thing" in "space," requiring "time." It is a manifestation of a redistribution of stresses in a field acting on matter, and the "matter" (behavior-stuff) which moves is composed of nodal points in an ocean of electrical density, which shifts its relative positions according to the variable patterns of tensions (electromagnetic, gravitational, molecular, etc.).

The complete account of this world-fabric, the space-time-matter manifold of nature, cannot be given here, partly because the physicist does not yet have a unified picture of reality. Such an account, when it is available, will represent a permanent synthesis of relativity theory and quantum mechanics. While we cannot now imagine in detail what such a theory will be, we may predict that it will be characterized negatively by the absence of the fallacy

of the absolute individuality of the subject, and this will be a consequence of the recognition of the relativity of substance. This realization comes not only through the application of Einstein's theory of the underlying equivalence of "matter" and "energy" and the primacy of *events* in the four-dimensional space-time continuum, but also through the recognition from an organismic viewpoint of the relativity of the "part" to the "whole." And just as previously we quoted from Weyl to indicate how the notion of the dominance of the whole is coming into its own in physics through quantum theory, so now we quote to the same effect the following passage from Max Planck's volume, *The Universe in the Light of Modern Physics*,[6] as follows:

> According to modern mechanics, merely local relations are no more sufficient for the formulation of the law of motion than would be the microscopic investigation of the different parts of a picture in order to make clear its meaning. On the contrary, it is impossible to obtain an adequate version of the laws for which we are looking, unless the physical system is regarded *as a whole*. According to modern mechanics, each individual particle of a system, in a certain sense, at any one time, exists simultaneously in every part of the space occupied by the system. This simultaneous existence applies not merely to the field of force with which it is surrounded, but also to its mass and its charge.

The reader will note the similarity between this statement and those previously quoted from Dirac and Weyl.

The point we have sought to establish through the arguments and quotations of the preceding pages is that both relativity theory and wave mechanics conspire to lead us to the same general conclusion: the need for a non-elementalistic theory of nature expressed in terms of a non-Aristotelian logic. In the interesting view advanced by Zawirski,[7] previously referred to (Chapter IV), this non-Aristotelian principle is stated in somewhat different fashion. This investigator argues that the duality of wave and corpuscular physics can best be understood in the light of the three-valued logic of Lukasiewicz, where we introduce "possibility" as a third alternative. The propositions of the wave and corpuscular theories are contradictory in a two-valued logic, but in a non-

[6] 1931; p. 32–33.

[7] "Über die Anwendung der mehrwertigen Logic in der empirischen Wissenschaft," by Zygmunt Zawirski, *Erkenntnis*, 1936–37, Vol. 6, pp. 430 ff.

Aristotelian logic which dispenses with the law of excluded middle the two are equally legitimate, in the sense that they are not true or false but *possible* Whether Zawirski's interpretation is to be preferred over the present view (which rests upon a criticism of the notion of *identity* when applied to the ideas of "substance," "physical states," etc.), remains to be seen.

IV. Conclusion

The next great step in the evolution of human thought is about to be taken. Will it succeed? And if it does, will it involve the same terrific struggle and high cost in human effort and suffering which progress in the past has always demanded? These are questions which only the future can definitely answer. But in trying to anticipate the answers one must remember that we are here not primarily concerned with the question, *Is a non-Aristotelian system true?* For absolute truth is a notion which, if not irrelevant to a non-Aristotelian logic, at most represents a limiting case in the range of truth-values (probability functions) of an *n*-valued logic. Certainly so long as present practical purposes and traditional habits of thought control our mental operations, non-Aristotelian systems will have few real applications. Nevertheless, in time new applications will probably be forthcoming and new habits of thought will be integrated into new types of adjustment to our physical and social environments. This is brought out in one way by E. T. Bell in his book *The Search for Truth*, when he tells us[8] that any one of the new logics may be expected to demonstrate its own mathematics, which will lead to new mathematical physics, and this in turn will suggest new "explanations" of the universe In the present volume we are trying to take some steps toward such an explanation.

Many other applications will in time appear, but we obviously cannot attempt to anticipate them here. In the next chapter we conclude our treatment of Part I by indicating one practical application in the field of social theory. Here we try to show how we may be guided in our choice of political philosophies, and if it should turn out that non-Aristotelian logic does nothing more than enable us to avoid some of the dogmatic absolutism of present stereotypes, this will be a discovery of no mean proportions.

[8] P. 262.

CHAPTER EIGHT

LOOKING AHEAD: FASCISM, COMMUNISM, OR HUMANISM?

The Humanist Hurricane is going to strike all Christendom before long. . . . Whether we should fly before that gale or seek to ride it out, is the most pressing problem with which Christian thought is confronted today.

—W. M. Horton

Recently a well-informed student of contemporary culture—Harry Elmer Barnes, to be specific—ventured the prediction that in ten years the organization of these United States would be either communistic or fascistic in nature. If the present social order is in the unstable equilibrium which this prediction supposes, and if the only choices before us are the two just indicated, I think we may well raise the question of whether it matters much which of these alternatives our own society accepts, since the end result will probably be the same. The argument of the above prophet, that our present form of economic-political system is doomed, probably is based in part on the familiar Marxist thesis that the inherent contradictions within the capitalistic state will bring about its own destruction. This may well be true, but, if so, it is hard to see how the fascist state which might replace it could do more than preserve for a few years more the moribund forms of a society committed to the price system and the profit motive. If capitalism will bring about its own destruction, the replacement of our present political democracy by the fascist state could be nothing more than a shot in the arm of the dying corpse of capitalism. For precisely the same chaos which is produced by laissez-faire policies operating within present capitalistic states will in turn overtake the subsequent fascist members of the "Western state" system. In other words, economic imperialism will do for the Western world as a whole what economic individualism does within the state, and the result is the same in both cases—

social, economic, and political chaos. Thus, if the only possibilities before us are those indicated, fascism appears as an intermediate state in the transition which has as its end result either communism or complete world chaos.

This brings us to a consideration of the fundamental question: Is it true that communism and fascism provide the only methods of remedying or removing the defects of contemporary society? Actually, it seems to me, we have allowed ourselves to be limited in our thinking by the imposition of stereotyped forms of solutions. If we allow our imaginations to play over the field of possibilities, we may readily discover other forms of social life which are preferable to either of the proposed alternatives. It is quite possible that both of these movements suffer from common defects. Humanism, for example, believing this to be the case, recommends its own program of social reform as deserving of serious consideration. To be sure, there are those who fear any sort of "ism," whether it be communism, humanism, or some other "ism." In justice to this fear it must be admitted that labels and "type" thinking are vicious things; nevertheless, if human beings are to co-operate in the business of tinkering with the social order in the interest of producing a just society, their co-ordinated efforts and common viewpoints must be designated by terms representing programs of actions. Humanism, we here repeat, is the least obnoxious of labels, and as a movement may well be the spearhead of the advancing frontier of intellectual progress and social reconstruction.

In explaining why humanism is to be preferred to either communism or fascism as "proposed roads to freedom," we want to make it clear that we do not start from the presupposition—as one philosopher does—that asking a person to choose between the two is like asking him whether he would rather be hanged or shot. Such begging the question does not contribute to understanding. The basis for the rejection of these alternatives has already been provided in the previous chapters, and reduces to the fact that both fascism and communism suffer from the common defect of dogmatic absolutism. In the present variety of humanism two other doctrines are fundamentally essential: (1) the theory of emergent evolution, and (2) non-Aristotelian logic. The combined effect of both of these doctrines is to undermine the absolute validity of the "law of identity," the acceptance of which is an integral

part of any finalistic social theory. Many reasons for the rejection of fascism and communism have been given, but no one, to my knowledge, has ever pointed out that they are both based upon an antiquated logical theory.

It is generally known that dialectical materialism is based on the fundamental thesis that the historical development of societies follows a foundational pattern which is the same, and the end of which is eventually the communistic state. This morphology of history assumes that there are certain cultural identities which recur in different societies. But the simple fact is that there never was a United States before and never will be another, when and if the present system passes away. *History does not repeat itself!* The theory of emergent evolution tells us that "identities" are at best analogies. This is not to deny that there are *similar* patterns of social evolution. In this field the Hegelian formula, later borrowed by dialectical materialism, is still perhaps as good as any other; but both assume a final goal: the German state in Hegel's view and state socialism in the Marxian theory. If, however, we accept the theses of humanism, later presented in Chapter XVII, that there is no final goal of the evolutionary process, and no absolute truth, and that even the law of identity does not hold rigidly in a world of emergent evolution, it follows that we cannot apply the Marxist formula to all cases. Even John Dewey, who is willing to defend the principle of identity when it is freed from any particular metaphysical interpretation, sees the fallacy of arguing from supposed social identities. As Dewey says:[1]

Particularly unacceptable to me in the ideology of official Communism is its monistic and one-way philosophy of history. . . . The thesis that all societies must exhibit a uniform, even if uneven, social development from primitive communism to slavery, from slavery to feudalism, from feudalism to capitalism, and from capitalism to socialism, and that the transition from capitalism to socialism must be achieved by the same way in all countries, can be accepted only by those who are either ignorant of history or so steeped in dogma that they cannot look at a fact without changing it to suit their special purposes. From this monistic philosophy of history, there follows a uniform political practice and a uniform theory of revolutionary strategy and tactics. But where differences in historic

[1] Cf. *The Modern Monthly*, April, 1934.

background, national psychology, religious profession and practice are taken into account—and they must be considered in every scientific theory—there will be corresponding differences in political methods, differences that may extend to general policies as well as to the strategy of their execution.

This states the matter about as well as it can be put.

The curious thing is that while Marxian doctrine borrowed the Hegelian dialectic, it did not borrow Hegelian logic. Hegel's rejection of the principle of contradiction—as previously noted—is the first clear case of a non-Aristotelian logic. If Marxism had borrowed this phase of Hegel's views, it would not have been Marxism, for then arguments based on cultural identities would have been impossible. It is precisely the failure to follow Hegel on this point which introduced defects into the attempted scientific analysis of social processes. It is not at all strange that economic finalism should presuppose an absolutism in logic. And by the same token, the easiest way to undermine all dogmatic absolutisms is to invalidate the logical presuppositions which provide the underpinning of such theorizing.

Contrary to all economic and political absolutisms, the newer humanism insists that we do not need to take society and its economic laws as something given, ultimate, and immutable. Communism and the laissez-faire capitalism which it seeks to replace both share in the common delusion that there is some sort of determinism in social evolution which is regulated by "economic laws." Fascism, to be sure, surrenders the laissez-faire economy of a self-regulating state, guiding itself by the invisible hand of economic laws; but, aside from the fact that a world-order of fascist states is impossible, fascism suffers from so many defects, as compared with a democratic society, that we may dismiss it as a workable scheme for the salvation of Western civilization.

Our humanism protests against any view which assumes that it possesses the final truth, once for all revealed. As between a supernaturalistic and miracle-inspired religion and the communism which seeks to annihilate it, what is there to choose? What matters it whether we worship Moses or Marx, Jesus or Lenin? Even if, on the theory of dialectical materialism, the processes of history should result in the production of a post-communistic state, its appearance and characteristics would be in accordance

with the ideology of the economic interpretation of history. In place of this view—fundamentally anti-evolutionary in one sense—humanism sees an evolving world in which the present emphasis upon "economic" drives is part of a culture-pattern characteristic of our present Western civilization. But to say that this principle must be dominant in all future forms of human living is to surrender to a form of intellectual provincialism unworthy of the "objective" spirit of a "scientific" society. The net result of this whole matter, then, is this: extreme left-wing reformers are ruled out from the present formulation of humanism, not because they are too radical, but because they are not radical enough!

But what, you ask, does humanism have to offer in place of these discredited alternatives? That is a long story. We have tried to tell a part of this story in the preceding chapters of the present book. In general, humanism is committed to the scientific method, the method of treating propositions as hypotheses to be verified by experiment and further observations. Scientific method is simply democracy in thinking, as John Dewey and Charles W. Morris have pointed out. On this view economic policies, like all other programs of action, must be regarded as tentative plans to be modified and discarded whenever social tests show them to be unsatisfactory. The humanist may well agree with the social radical that the present order is full of defects, or even doomed to destruction, but rather than sacrifice the present generation to fulfill a prophecy from the Mount Sinai of socialism, he prefers to labor and recreate from the materials at hand. No liberal of today denies that we need a much larger measure of industrial democracy to match our political democracy (such as it is); but the one glaring defect of present-day democratic society is that scientific method, or democracy in thinking, has not yet been given a fair chance in the arena of public life and social action. When that is accomplished, humanism may have a chance in the progressive refashioning of the social order.[2] What this social order may be like we shall try to envisage in PART III.

[2] In several articles in the *Journal of Social Philosophy*, which he edits, Dr. Moses J. Aronson has been applying humanistic ideas in social theory. And in the *Humanist Bulletin* Mr. Edwin H. Wilson has been carrying on the same task in religion. These men are doing pioneer work.

PART II

THE WORLD OF EMERGENT EVOLUTION

CHAPTER NINE

THE DUALISMS OF TRADITIONAL THOUGHT

I think no one can study the evidence in its detail without becoming convinced that we are in the presence of one of the most profound reorganizations of scientific and philosophic thought.

—A. N. Whitehead

I. Traditional Habits of Thought

For centuries the human intellect has faced certain problems, the endless discussion of which has, to a large extent, constituted the content and defined the scope of metaphysics. These problems were set by certain dichotomies which have been established, including the traditional opposition of *soul* and *body*, and the more recent dualisms of *life* and *protoplasm*, and *energy* and *matter*.

There is little difficulty in understanding why the very mode of statement has rendered insoluble the problems of "interaction" which have thus been created. If we make of matter a kind of existent somehow qualitatively different from energy (force, or *vis viva*, in the older physics), it is not to be wondered at that we have on our hands the problem of explaining the interrelations between the two. Indeed, in connection with this dualism, it will be recalled that among the seven world enigmas which Emil du Bois enunciated, he listed the problem of the nature and the connection of force and matter, prophesying that this would ever remain one of the insolubilia of human thought. In the same way, if living processes be hypostatized into a reality of a category different from biochemical processes, we inevitably face the problem of explaining how a meta-empirical entity, by hypothesis different from the physiological realities which are taken as the "physical basis of life," can act upon spatial configurations of matter, without doing violence to the laws of physics and chemistry. Finally, philosophy and psychology have created for themselves another of these riddles in conceiving the mind to be a

reality over and above the nervous mechanisms through which it is held to express itself.

Now so long as the one end-term of a dualism is held to have nothing in common with the vehicle which serves as the seat of its operations, it is inconceivable how these two realities can interact upon each other. Our explanation of the type of thinking which creates these insolubilia is that these dichotomies of thought arise out of the habitual Aristotelian tendency to reify into an entity any kind of activity which can be treated as sufficiently integral with respect to the environment to be labeled with a term. Thus "life" and "mind" have been hypostatized into substances of a metaphysical sort. But in a truly universal behaviorism these "things" (matter, life, mind, etc.), which have been elevated by materialists, animists, and vitalists into self-subsistent and independent entities, will be held to be complications of movements (or events) that do not pass, because, in the span of attention in which they are isolated, their behavior appears as unitary with respect to the contexts or fields in which they occur.

In the previous chapters we have examined the logic which has lured us into this substance-action mode of thought. Judgments about the external world are put in the form of propositions, and traditionally the "substantialistic" parts of propositions have been represented by *subject terms*, or *class names*. These terms are conceptual devices whereby, through a process of abstraction, the behavior-complex is lifted from its circumambient environment and made into a thing of its own right. Concepts thus epitomize flowing patterns of motion into entities, and for purposes of simplification in adaptation to our external world we reify these unitary modes of behavior in order to deal with them as integral in relation to more remote ends to be attained. For example, we treat a crystal as a "thing," rather than as a dynamic synthesis of behaving molecules of a space-lattice. Thus, as with the terms "cause" and "effect," there is a pragmatic sanction for the distinction between "substance" and "action." But if we are to remain free from the older practical and philosophical prejudices, we must constantly keep in mind that "substance" or "matter" is only a kind of resting-place for thought, expressing a kind of intellectual fatigue or unwillingness to analyze further.[2] What is a substantial level referred to one stratum of observation may be an energy level referred to another. Even the dualism of matter and

energy, therefore, may be treated as a special case of the traditional psychological procedure whereby we adjust ourselves to the passage of external nature.

Still continuing the summary of our argument up to this point, we have noted that philosophers are on the road to freeing themselves from slavery to traditional habits of thought when they come to see that the concept of anything is the *law of its behavior*, because *a thing is what it does*. Scientists have come to this emancipation by a somewhat different route. Open hostilities between traditional materialism (and even vitalism is guilty of the "materialistic" mode of thinking) and the new view began when physicists developed the suspicion that "energy" and "matter" are not totally different realities, but have much in common. The final overthrow of materialism is completed when the view is adopted that what was formerly regarded as a pure wave phenomenon (light) has some of the properties of matter, while what was considered a particle has some of the properties of waves. When an important fact needs to be kept in mind there is everything in having a name for it; hence the timeliness of the suggestion of Eddington that we coin the term *wavicle* to designate the mutual infectedness of "waves" and "particles."

This is the situation as we have interpreted it up to this point. Now, in Part II, we propose to extend our logical theory into the field of the philosophy of nature. We begin by an examination of the most universal features of our external world. Following that, we proceed up the ladder of emergent evolution, striving to give a coherent account of the creative advance of nature as it has unfolded itself to us.

II. Body and Soul

One of the purposes of Part II is to criticize the older dualistic theories, previously referred to, and then suggest an alternative doctrine. But first we must understand the reasons which have been given in support of such views. This is the purpose of the present chapter. Accordingly we first glance at one classical defense of dualism, the doctrine of Plato as it is expounded by his spokesman, Socrates. In the *Phaedo* Socrates is discussing with others a point of view which, after examination, he rejects because of its inadequacies. The theory which Socrates finds unacceptable is the idea that the soul is the harmony of the body. It will be

remembered that Pythagoras, who saw in number patterns and numerical ratios the explanation of all natural phenomena, and who also made discoveries concerning the mathematical basis of musical harmony, had invented the musical scale which was later to evolve into the generally accepted scale of European music. It is clear, therefore, that the facts concerning the relation between the lengths of vibrating strings and the corresponding tones which they give forth were known to the Pythagoreans. Accordingly it was to be expected that some speculator acquainted with the idea of this philosopher-scientist would suggest that what is called the soul is comparable to musical harmony. In the *Phaedo* this idea is presented and discussed. The body is here compared to a lyre: just as the lyre has strings of varying lengths, so the human body has strings set in its frame. Both produce a compound which is harmonious when there is a proper admixture of parts. Harmony, as Plato puts it, is a thing invisible, incorporeal, divine, abiding in the lyre which is harmonized—though the strings are matter, composite and earthly. This view, attractive as it is, is rejected by Socrates, who, destined to drink the cup which is to immortalize him, is interested in finding a theory which guarantees something more than social immortality. And so Socrates (or Plato) spurns this view, and finds three reasons for doing so. In the first place, harmony in music is not prior to the elements which compose the harmony. If the soul be simply the harmony of the body, the soul cannot exist prior to, or after, the instrument of which it is the harmony. But Socrates is not willing to grant that the soul perishes with the body. Plato and Socrates, like other Greek philosophers, favor the doctrine of transmigration of the soul.

A second reason which Socrates finds for rejecting this view is found in the fact that harmony does not lead the parts which make up the harmony, but only follows them. To quote Plato's own words: ". . . the soul, being a harmony, can never utter a note at variance with the tensions and relaxations and vibrations and other affections of the strings out of which she is composed; she can only follow, she cannot lead them." But Socrates then argues that we actually discover the soul doing the exact opposite—leading the elements of which, by this theory, she is actually composed. The soul is always opposing and coercing the body. Undoubtedly it is this feeling of compelling the body against its

own inclinations, the feeling of a struggle against the "lower" desires of the "flesh," which lends plausibility to the dualism of soul and body We find this interpretation implied in Paul's observation that the things he ought not do he does, and the things he does he ought not do. It is this conflict between a higher and a lower nature which leads him to declare that there is a body spiritual and a body material. In the view here proposed we hold that the struggle is not a conflict between the soul and the body, but between the desires of special or segmental cravings and the total momentum of the body as it is integrated into a unified whole.

The final reason why Socrates rejects this view lies in the fact that harmony admits of degrees, whereas the soul does not. According to Socrates we cannot admit that one person is more or less of a soul than another person. This view follows from the definition of the soul as a thing simple, indivisible, and not composed of parts. By way of reply, and in defense of the view that the soul is the harmony of the body, we insist that our definitions should not be asserted on a priori grounds, but must be framed on the basis of factual observation. The fact is that the human personality, or the soul, is not simple and indivisible. We know too much of multiple or split personalities to assert that the soul does not consist of "parts." Also the soul admits of degrees. We can speak of some persons as having more or less of a soul than others. And the test of the degree of soul life is a question of the wealth and variety of interest and richness of content of integrated experience.

In the view which Socrates and Plato defend we have clearly presented the dualistic theory of the relation of soul and body. In more recent psychology this view that the mind coerces the body is termed the doctrine of "ideo-motor action." Ideas are said to be dynamogenic in the control of conduct. Such a view corresponds to the parallel doctrine in biology known as "vitalism." As the reader knows, in modern thought these views have been and are much criticized. It is argued that the history of science illustrates the truth of the statement that in its earlier stages science always involves an animistic or vitalistic view, and that as time goes on science tends to become more mechanistic in character. Since we will be discussing these two contrasting views at some length, let us define the sense in which we propose to use the terms "mechanism" and "vitalism."

By a mechanical or mechanistic view we mean the doctrine which holds that any reality of nature is nothing but the material units or structures out of which it is made, and the behavior of such a structure is predictable from a knowledge of the laws of behavior of its elementary constituents. By a vitalistic theory we mean the doctrine which holds that the functions and modes of behavior of any specified reality of nature cannot be explained entirely in terms of the material units or elements into which it can be analyzed. Function cannot be reduced to structure. But if what a thing does is not to be explained by its structure, what is its explanation? Vitalism always involves the assertion that what a thing or organism does is caused by some agency or force which acts upon the configuration of material elements. This force or active principle is capable of separation from the structure through which it functions or expresses itself. In this way of stating the matter it is evident that vitalism is not a term restricted solely to biology One may have a vitalistic physics as well as a vitalistic biology or psychology. It is important to keep in mind that vitalism, regardless of the field in which it appears, always involves a dualism. It asserts that matter or body is inactive, inert, passive, and that the cause of the active functioning of matter or body is the force or agency behind that body. Matter or body is that which is acted upon by force.

III. The Traditional Dualisms

The oldest of the dualisms of human thought is the antithesis of soul and body. Obviously it is what is termed "psychological dualism." Later on, when the biologist had arrived at the notion of the "physical basis of life," there appeared the dualism of protoplasm and life (or the "vital force"). This is biological dualism. The corresponding opposition in physics is the antithesis between matter and energy. It is difficult to state just when these dualisms first appeared in human thought, but they are all present in Greek philosophy four or five centuries before the birth of Christ. These dualisms still exist. Let us set them down for future reference:

Matter and Energy (or Force)... ....in physics
Protoplasm and Life.... ....in biology
Body and Mind (or Soul).......................in psychology

In order to weigh the truth and merits of the views of nature which are given in the mechanistic and vitalistic explanations, we must first understand the motives which lead to the oppositions in the foregoing vitalisms.

In recent years we have heard much of the conflict between science and religion, between the mechanistic and the idealistic attitudes toward nature and man. In early thought this conflict did not exist, because these distinctions in interest and occupation were not yet established. Science, religion, and philosophy were united in primitive thought. The conflict first appears when the theory of matter embodied in classical materialism (atomism) is presented. It is only when science develops as an independent interest, freed from bondage to religion and mythology, that theories of matter appear which provide no place for the vital forces of the animistic system. And when the notion of matter is thus "devitalized" so that a body is so conceived as to be incapable of initiating change, it is necessary to find in some extraneous force which acts upon matter the generative principle of motion and development. If this is true, it follows that the development of physics, with the concomitant tendency toward the mechanization of matter, has contributed in no small measure to the growth of vitalism in all other fields. The assumption which is implicitly made, and which seems to make it necessary to introduce vital forces, is the notion that rest is more natural than motion. But why, we may ask, should this assumption become incorporated into historical materialism? Why should the conception of matter have developed in such a way that human beings have come to believe that, if a thing is active or in motion, we must suppose that there is some sort of agency or force which is responsible for that behavior? Perhaps the answer is that we human beings are naturally lazy, and cannot understand why anything else in nature should exhibit activity unless "forced" to do it. This explanation of why rest should appear more natural than motion may have some truth in it, though it is probably unjustifiably exaggerating the slothfulness of human nature. Perhaps the statement may be rephrased as follows: The notion that rest is more natural than motion, and hence that moving bodies must be acted upon by coercing forces, is not so much a consequence of the laziness of human beings as it is of introspectively noting the fact

that when we do move external objects there is always present a conscious sense of "effort."

It is now generally admitted that this sense of effort, the sense of muscle strain when lifting or pushing external bodies, is the origin of our notion that when bodies move they are acted upon by "forces" from without. Thus the notion in physics of force is an anthropomorphism. It is the result of our projection into nature of our own sense of effort. In every case of the foregoing dualisms the second term of the antithesis is the active cause which overcomes the inertia of inactive bodies. Inertia here means the tendency for a thing to remain in its same (previous) state. We have already noted how this idea appears in Plato. It may help us to understand the psychology of a dualistic view if we now examine the manner in which this idea that motion is not natural (that is, self-explanatory) appears in Aristotle.

What is the cause of motion? In answer to this question we ordinarily point to some antecedently operating force which is believed to produce the given motion. But we can always find another antecedent state or cause which preceded our original cause. Are we therefore compelled to admit that the cause of any given state was the preceding state, and that this state had its own antecedent state, and so on *ad infinitum?* If so, we must admit that motion is eternal, and that there is no first cause of motion, since motion then has no absolute beginning. But—as we have previously observed—rather than admit the possibility of an infinite regress, and thus leave motion "unexplained," Aristotle argues that we must stop somewhere, and this absolute beginning or first cause of motion, he states, is God. We thus have an eternal and Unmoved Mover who is the ground of all subsequent motions and developments, but Himself is unmoved and unchangeable. Hence God for Aristotle is that being in terms of which everything else is explained, but who himself is forever inexplicable. This argument of Aristotle's—an integral part of the Aristotelian logic which underlies the Aristotelian metaphysics of space, time, form, and matter—is one of the classical proofs for the existence of God. As an explanation of the "origin" of motion it still appeals to many minds.

It is easy to see how the doctrine of relativity cuts under this argument. By introducing the notion of the relativity of motion Einstein removes the last vestige of the notion of force as a cause.

By insisting upon the relativity of time measurements, Einstein abolishes the notion of absolute beginnings. Finally, by showing that we cannot separate the containing vessels of space and time from the content (matter), the relativist completely removes the foundations which support the idea that space and time could exist even though there were no matter "in" these "containers." But we now know that time and space are not the containers of matter, and that if there were no matter time and space would cease to exist. Hence it is nonsense to talk about absolute beginnings or first causes of motions, if by this we mean that matter and motion appeared at some specific date in the past of a temporal series which was flowing along before the physical universe was. But these are recent ideas, and thinkers of earlier ages could not avoid the errors which the theory of relativity now warns us against. Hence it is easy for us to understand why, once the idea was established that the motions of bodies require forces for their explanation, it was natural that philosophers and scientists should introduce these principles *ab extra* to explain each new level of behavior or each realm of functional activity.

Those who were responsible for these previously mentioned types of dualism had noted the following levels of functional activity: (1) the difference between matter at rest and matter in motion; (2) between inanimate bodies and living organisms; and (3) between conscious human beings and unconscious living forms (such as plants). Since the activities of each of these levels called for a distinct kind of cause, the following types of forces were invoked: (1) *Energy*, as that which causes and directs the motions of inanimate matter; (2) *Life*, as that which causes and directs the motions of organisms; and (3) *Mind* or *Soul*, as that which produces and directs the motions of human beings. In each case the active cause is responsible for the behavior of the material complex upon which it acts. Each new type of behavior is explained by the introduction of a new type of entity or force. This type of explanation is a consequence of the inveterate tendency of our reasoning processes to make entities out of modes of behavior. This process of hypostatizing functions so that they are the expression of imponderable forces is illustrated in primitive man's explanation of insanity, headaches, and disease as being due to the presence of some agency, force, or spirit in the individ-

ual who thus becomes obsessed. The practice of casting out devils, and the surgery now called "trepanning" which primitive man sometimes resorted to in order to provide an opening in the skull through which the enclosed spirit might escape, illustrate the practical effects of this type of explanation. This mode of thinking is also illustrated in the early history of chemistry, where all sorts of caloric fluids and phlogistons were injected into matter to explain its chemical behavior.

Now that we have a thumbnail sketch of the historical development of our problem before us, we must next ask ourselves what we can do to resolve the dispute between the mechanists and the vitalists. By way of beginning, let us raise the question of whether these are the only choices before us, or whether there is another possible point of view, a *tertium quid*, which has been overlooked? If we refer back to our discussion in Part I, it will be recalled that the movement popularized by the term "emergent evolution" is held by its advocates to provide an escape from the horns of the vitalistic-mechanistic dilemma. And the defenders of the theory of gestalt psychology also claim that their view disposes of the old antithesis. Obviously it is not necessary to choose either mechanism or vitalism—we may reject both if we wish. This we propose to do in the view which is here being defended.

IV. Structure and Function

In the traditional dualism which we have just examined, it is evident that the terms of the three antitheses involve an opposition between that which is acted upon and that which produces the action. We have, in other words, a dualism of substance or matter on the one hand, and force or activity on the other. Apparently the materialist emphasizes the structural or substantialistic aspects of reality, while the vitalist emphasizes the functional or activity aspect of the reality he studies. That is to say, the dualism of substance (or matter) and action (caused by "force") is but a special case of the dualism of the structural and the functional.

More fundamental than the dualism of mind and body, of life and protoplasm, of energy and matter, is the dualism of the static (or structural) and dynamic (or functional) aspects of nature. It is our belief that this ubiquitous dualism of the structural and the

functional has its origin in the dualism of space and time. In other words, the thesis here presented is that energy, life, and mind are designations of the dynamic, functional, or temporal aspects of realities of which matter, protoplasm, or body are the static, structural, or material designation. Life and mind, standing as they do for the functional aspects, are therefore to be regarded as forms of temporal organization. Whenever any structural complex or configuration of material elements is so unified into a temporally integrated whole that we have what we have variously called a "unitary mode of behavior," or a "macroscopic rhythm," *there mind is present.* Mind or soul, therefore, is not a gift from on high; it is an achievement by organisms. In place of meta-empirical forces invoked to explain the various levels of behavior in nature, we must substitute the notion of dynamic syntheses. An entity (for example, molecule, crystal, organism) behaves as it does not because, as a going concern, it possesses or is acted upon by supernatural forces, but because it is integrated into a unitary mode of behavior. Energy, life, and mind, therefore, are functional unities. In schematic form we have:

The Spatial Aspect	*The Temporal Aspect*
Material	Activistic
Substantial	Energic
Structural	Functional
Static	Dynamic

This allows us to make various analogies or proportions. Thus we may say that soul is to body as life is to protoplasm, or as time is to space. Since in physics energy is associated with the dynamic aspect of which matter is the static aspect, we can also assert that energy is the soul of matter. But it has already been stated that soul is the harmony of the body. In order that these views may square up with each other, we must reinterpret the meaning of the concept of energy in such a way that the changes initiated by physical energy are understood to express the striving for harmony. This is a view which physicists have neither discussed or espoused, and at this point some of the prosaic scientists of the older school will be inclined to exclaim, "What nonsense is this you are uttering! What has energy to do with harmony?" This we must now to try to show.

V. Energy as Harmony

In defense of this view let us first note that energy is commonly held to be of two forms, kinetic energy of motion and potential energy. A body is said to possess potential energy when it has the capacity to do work. But what confers upon it this ability to perform work? The answer usually given is that bodies possess potential energy by virtue of their position. Potential energy may therefore be said to represent the tendency to change position or spatial location. A body possesses this tendency and capacity because, in the position in which it is, the forces concerned are not in equilibrium; or if they are, it is an equilibrium under stress, and when the equilibrium is upset a readjustment occurs in which the forces involved tend to alter the positions of the bodies concerned in such a way that a more stable equilibrium results. But what is there about the position of material objects or particles that gives them this capacity to perform work? What is there in common between the chemical energy of a carbon molecule and the rock perched on a cliff? Here we have a mystery.

The best guess concerning the nature of potential energy seems to consist in trying to articulate in more detail the conception of stresses and strains that are supposed to be associated with potential energy. These strains were formerly supposed to exist in the ether of space, but since the ether, like the Cheshire cat, has attenuated itself almost to the point of non-existence, we find it difficult to imagine an elastic distortion in something which does not exist. However, as we shall see in subsequent chapters, we still have with us, in one form or another, the notion of the electromagnetic field. Here is one reality of the older physics which is still in good repute. Perhaps, then, the potential energy due to position has for its basis the stretched condition of the lines of force which are associated with the configurations of material elements. Physicists tend to regard "lines of force," which, for example, lie between a magnet and a piece of iron, as a kind of geometrical abstraction; but Faraday, who first presented this theory, took them to be actualities. Moreover, Sir J. J. Thomson, who conceives the ether to possess a filamental structure, also thinks of Faraday "tubes of force" as physical realities. If this conception, in which the field of force takes the place of the older ether of space, should continue to preserve its good standing, we shall have to think of space as spider-webbed with interlacing

lines of force. We may then interpret the behavior of material bodies in terms of tensions and relaxations within energy fields. And here is where the notion of harmony comes in.

Nature is trying to establish conditions of equilibrium She is seeking to reduce the potential energy of bodies The resulting shifting of the gradients of the energy-fields upsets the equilibria of other bodies which are thereby influenced. The (relatively) isolated configurations within nature must adjust themselves to other and neighboring configurations, with their own energy potentials. Since the motions resulting from the conversion of potential energies of bodies into kinetic energies are due to relative positions and relative patterns of influence, we cannot interpret potential energy in terms of single bodies alone. We must seek for the explanation of motion in the universe as a whole. The activities of material complexes must express the impulse toward readjustment on the part of the cosmos in its entirety. This is consistent with what the general theory of relativity expresses in the statement that "*gravitation simply represents a continual effort of the universe to straighten itself out.*"[1]

An absolute equilibrium condition, involving the universal rest of an Aristotelian God, is possible only if the energy fields associated with the various microscopic material complexes are integrated into some macroscopically equilibrated pattern of lines of force. But equipotential surfaces running through all the dimensions of the universe as a whole seem to be impossible. There seems to be some tendency in the universe which opposes such an absolute equipoise. What this tendency is we shall surmise in the next chapter. The point which is important here is that it is no mere figure of speech to say that nature is trying to produce a harmony out of the body of matter with which she has to work. In this sense nature has something of a soul, and the soul is the integrated energy fields and constellations of lines of force associated with the potentials of positional objects.

According to this view, consciousness is related to the potential energy of matter, and this forces us to conclude that we can find in "inanimate" matter the promise and potency of mind. It also follows that adaptive behavior in organisms has its earliest analogy in the "adaptive" behavior of inorganic bodies. A rock

[1] Cf. E. T. Whittaker, "The Outstanding Problems of Relativity," *Science*, Vol. LXVI, 1927, p. 227.

tending to fall down a cliff has the same sort of directed response which in living organisms we call "instincts." But in the former situation there is lacking that integration and intensification of energy which is present in complex organisms. Nevertheless, it is correct to say that wherever in nature there is a store of potential energy in an unstable equilibrium, which can be released by a trigger effect; wherever in nature an object is under stress and is trying to equilibrate itself with its environment by reducing its potential energy to a minimum (in accordance with the second law of thermodynamics), there we have the condition for the presence of consciousness. Energy is the soul of matter because it represents this persistence of tendency in doing work; and soul is regarded as the harmony of the body because it represents the integration of energy fields as they are unified into a dynamically functioning complex of behavior-stuff.

Such an interpretation of potential energy may seem to secure little support or encouragement from physics itself. But this is because physicists in the past have entered into a kind of unconscious conspiracy not to admit that the phenomena of physical nature might be explained in other ways than those which have been fashionable in classical physics. All textbooks were written in such a way as to maintain the uniformity of doctrine which was to be found in them. But that we actually have a choice among different types of physical philosophy is one of the secrets which the physicists can no longer keep to themselves. The secret is out, and now mischief is afoot. Let us justify the apparently heretical doctrine that alternative types of physics are available to those who like variety in their intellectual menus.

VI. The Concepts of Physics

A few years ago the opinion was generally held that the mechanical picture of nature which physics presents is an actual (objective) portrayal of the situation, that physics has solved all of its important problems, and that no radical reconstruction of its fundamentals was at all likely. The universality of this view was largely a consequence of the fact that most textbooks to which the average reader had access were concerned with the same subjects, treated these subjects in approximately the same manner, and agreed in most of what they had to say. And so the belief was current that there were no elements of choice, arbitrariness,

or subjectivity in physical science. Physics was supposed to give us an objectively real account of nature, free from all anthropomorphism. This idea, we now know, is not altogether true. In order to see why this is the case let us review the method by which physics proceeds in building up its system of explanatory concepts.

The general procedure of physics consists in defining certain primary magnitudes and then constructing from these the derived magnitudes. These are built up by combinations of fundamental magnitudes. Physicists generally select length (L), mass (M), and time (T) as the primary units. This procedure gives us the centimeter-gram-second system of measurement. Now let us observe how the derived magnitudes arise from these primary magnitudes. Velocity, as we all know, is directly proportional to the distance covered by the moving body and inversely proportional to the time; or, $V = L/T$. To state the matter in other terms, velocity is the time-rate of change of position. If the velocity of a body is not constant, but is uniformly accelerated, then the velocity of a body at the end of t seconds is expressed thus: $v = at$, where a is the acceleration. In other words, acceleration is the time-rate of change of velocity. In a similar way we can go on to define force as the space-rate of change of energy. We may summarize these facts and the method by means of which the process is carried on in the following table of derived magnitudes:

Velocity	= cm. per second
Acceleration	= cm. per sec. per sec.
Force	$= M \times a =$ dyne
Work	$= F \times S$
Power	$= \dfrac{\text{Work}}{\text{Time}}.$

We can express these physical quantities in terms of length (L), mass (M), and time (T). Whenever the symbol T^{-1} occurs, this means that time appears in the denominator:

Area	$= L^2\, T^0\, M^0$
Volume	$= L^3\, T^0\, M^0$
Velocity	$= L^1\, T^{-1}\, M^0$
Acceleration	$= L^2\, T^{-2}\, M^0$
Force	$= L^1\, T^{-2}\, M^1$
Energy	$= L^2\, T^{-2}\, M^1$

This method of scientific procedure is very useful. Its effect becomes vicious only when we conclude that, since we can express the qualitative results studied in the higher sciences (psychology and biology, for instance) in terms of complexes of the simple units of the primary magnitudes, therefore the data studied in these sciences are reducible to physical magnitudes Even this would not be misleading provided we were willing to read into physical reality the properties and qualities of the original phenomena which were thus analyzed into physical magnitudes. For example, there would be no objection to the view that when we analyze the activities of living organisms, such as growth, self-repairing processes, etc., into surface tensions, ionic migrations, osmotic pressures, phasic equilibria, etc , the adaptive behavior of life is these chemical reactions in their dynamic interactions. But when we do this we must be willing to admit that inorganic chemical reactions contain within themselves the essence of that which appears in organisms as purposive response. It is clear that chemistry as ordinarily interpreted does not permit of this vitalization of physical reality.

A knowledge of the manner in which physics came to be interpreted in a materialistic-mechanistic way will convince the student that physics might have been, and still may be, interpreted in such a way as to provide the basis for purposive behavior. The failure on the part of some scientists to recognize this fact is a natural consequence of the ignorance on the part of these scientists of the historical evolution of the science of physics. It is particularly clear that some modern thinkers do not sufficiently appreciate the importance of the interaction of the views of Descartes, Leibniz, and Newton, and the manner in which the triumph of Newtonian physics determined the course of the subsequent development of physical doctrine—as we shall see in a later chapter.

The view we are here advocating rests on the belief that in order to arrive at a doctrine in which human purposes do not appear as alien influxes into a hostile physical world, we must, like Leibniz, reinterpret the notion of matter in dynamic terms. This is precisely what modern physics is doing. Aside from the contributions of wave mechanics, one can make out a good case for the thesis that relativity theory throws considerable doubt upon the assumption that "length," "work," "potential," etc., are

objectively invariant existents. Thus, in his book *The Mathematical Theory of Relativity*, Professor A. S. Eddington is quite ready to admit that there is more anthropomorphism in physics than physicists of the recent past were willing to admit. This same idea is also brought out by Norman R. Campbell in his book *Physics: The Elements* (Chapters X, XIV, XV), where it is recognized that both derived and fundamental magnitudes contain an arbitrary element connected with the choice of units. Mass, length, and time, Professor Campbell points out, are not necessarily basic magnitudes, but such special features as they possess are derived partly from the dynamic equations in which they occur and the high accuracy with which weights and lengths (but not times) can be compared.

All this, of course, merely illustrates the point that there are various ways in which the behavior of the elements of the physical world may be described and explained. In the past it has seemed convenient and fruitful to exclude certain ideas, such as the notion of purpose, from the physical world. But the fundamental ideas of physics were enunciated before the days of evolutionary thought, when the notion prevailed that physical nature and human experience were mutually exclusive realms. Now the time has come to take seriously the implications of the idea of evolution, implications which are important for physics as well as biology. This we propose to do in the remaining chapters of Part II.

CHAPTER TEN

THE PHYSICAL WORLD: UNIFORMITY AND INTEGRATION

The materialistic theory has all the completeness of the thought of the middle ages, which had a complete answer to everything, be it in heaven or hell or in nature. There is a trimness about it, with its instantaneous present, its vanished past, its non-existent future, and its inert matter. This trimness is very medieval and ill accords with brute facts.

—A. N. Whitehead

I. Induction and the Uniformity of Nature

The aim of the philosophy of science is to rationalize the facts of nature: to introduce order into the chaos of facts yielded by the various sciences, through exhibiting the interdependencies of these facts as part of that system of things which is called the "order of nature." To accomplish this synthesis, it must be possible to show how the individual phenomena within any restricted field can be fitted into a wider scheme as logically consistent items within a more universal framework. This implies that the processes involved in the various isolated phenomena of nature are, at bottom, similar in character. As Poincaré states the matter,[1] every generalization presupposes a belief in the unity and simplicity of nature; and, we may add, it therefore appears that progress in science can be achieved only through the formulation of theories of increasingly wider scope. In consonance with this assumption that there is an Ariadne's thread running through the tapestry of evolution, scientists have tried to discover a set of generalized formulas holding for the integration of material aggregates, as well as for protoplasmic synthesis and the unity of mind. In the present chapter we are concerned with the advances that have been made in the philosophy of the physical world.

[1] Cf. *Science and Hypothesis*, by Henri Poincaré, 1905, p. 145.

Any theory of nature which hopes to explain the abundant success of the natural sciences in the prediction and control of the processes of nature must provide a theory of induction that will effectively answer the skepticism resulting from Hume's destructive criticisms of induction.

It is an axiom of science that under similar conditions the same things will behave in similar fashions. This belief in the simplicity of natural laws (uniformity of nature) may be called mystical, Professor G. N. Lewis tells us,[2] since we have not the slightest idea whether its undoubted usefulness is due to the structure of the external world, or to some hitherto unanalyzed trait of human psychology. Nevertheless, science can never surrender this belief, and still remain science. No matter how desperate the situation, it is always assumed that no difficulty in science is so hopeless as to put us to permanent intellectual confusion. There will always remain the "faith" that we may again discover one of those new simplifying generalizations which Poincaré believed to underlie progress in science.

The various scientific attempts that have been made to provide a theory of induction usually rested upon the belief that the orderliness of nature is due to some "conservative" tendency in the universe. The "law of parsimony" and the "principle of continuity" are different expressions for this faith in the ultimate rationality of things. The principle of the conservation of energy is frequently appealed to as the physical background of the uniformity of nature; but since this principle, sometimes called the first law of thermodynamics, is now, like its partner the second law of thermodynamics, interpreted as being a statistical generalization, there is some question as to the validity of grounding the uniformity of nature upon it. Moreover, as previously noted, it is the quantity known as *action*, or energy integrated through time, rather than energy itself which is conserved. Perhaps, as relativity theory says, this is because action represents the "curvature" of the world.

So far as the writer is informed, the most promising theoretical justification for the belief in the uniformity of nature is set forth by Dr. S. Alexander in his work, *Space, Time and Deity*. Here

[2] "Ultimate Rational Units and Dimensional Theory," *Philosophical Magazine*, Vol. 49, 1925, pp. 739–750.

order is grounded in the uniformity of curvature of that most pervasive framework and matrix, space-time. Philosophers have long been puzzled about the relation of concepts and categories—which are "mental" products arrived at through a process of abstraction and generalization—to the physical universe. It is here that Dr. Alexander's doctrine is of peculiar value. By showing that mental space and time are part of the same total space-time as are physical spatio-temporal relations, Alexander's view spans the gap between mental habits and the order of the external world, and thus answers Hume's criticisms. In a universe of space-time, universals or concepts are spatio-temporal habits or patterns of motion. Universals and invariants can repeat themselves in the particulars of sense experience because space-time is uniform—that is, has a constant curvature—and therefore behaves on plans which are undisturbed by differences of place or time. Thus the universal is related to the particular as the equation of a curve is related to the instances which can be obtained by varying the so-called constants of the equation. In this way the conceptual processes of induction appear as special cases of the orderliness of the cosmic continuum.

To a certain extent this theory appears to run counter to the general theory of relativity. Like A. N. Whitehead, Dr. Alexander conceives the uniformity of curvature of the metrical manifold to be due to the universally isotropic character of space-time. "Matter" must therefore appear as a "mutation" within a historically prior stuff, space-time (an "ingredient" in events which "does not pass," in Dr. Whitehead's terminology), whereas, for the "orthodox" school of relativity, space and time could not exist if there were no matter. There are certain advantages and disadvantages attaching to both views. On the whole it seems to me that it is more difficult to suppose that matter could "emerge" from the space-time continuum than it is to suppose that the space and time manifolds are abstractions from an eternally existent and amalgamated universe of space-time-matter. However, we may retain the advantages of the Alexander-Whitehead view by assuming that, aside from the local unevennesses of the *field*, space as a whole has a constant curvature which is determined by the average density of matter, or its mean distribution in space-time.

II. The Continuant

The average person is unaware of the extreme difficulty of defining what constitutes a "thing." It is recognized by the philosopher that a thing is to a certain extent a "teleological construct." That is, the "permanence" of a thing depends upon whether, for certain purposes, it is just as good (useful) as it was previously, even though it may have lost, through friction, millions of molecules, and gained millions of others through accretions. The problem becomes still more complex when we discover that the constancy of a thing is also relative to the physical frame of reference from which it is observed. Thus Bertrand Russell tells us[3] that "We cannot speak in any accurate sense of the 'history' of a piece of matter, because the time-order of events is to a certain extent arbitrary and dependent upon the reference body." But even allowing full weight to these facts which indicate the extent to which the observer's "apperceptive synthesis" enters into the "thinghood" of the object perceived, nevertheless it seems that each *type* of object in nature (electrons, atoms, molecules, etc.) must possess a unitary mode of behavior peculiar to itself. Whether, in the percipient event—thinking of matter in the bulk—the observing organism superimposes this unity upon the group of multiple elements with which it is "cogredient," as Whitehead would say, or whether this behavioral unity is a real feature of the external thing itself, is an old—and an ever-new—problem. Eventually the difficult notion of "simultaneity" is involved. Dr. Whitehead's solution to this problem, as stated in his earlier volume *The Concept of Nature*,[4] is found in his suggestion that "amid the alternative time systems which nature offers there will be one with a duration giving the best average cogredience with the subordinate parts of the percipient event." Our own attempt at solving this problem, which involves an effort at reconciling the relativity and the absolutivity of motion, will be presented later, but in passing we may note that Whitehead's speculation[5] that the alliance of the passage of nature with the passage of mind, given in sense awareness, arises from their sharing in some ultimate

[3] Cf. "Physics and Perception," *Mind*, Vol. 31, 1922, p. 479.

[4] 1920; p. 111.

[5] *Ibid.*, p. 69.

passage which dominates all being, comes pretty close to the idealistic theory of nature!

In our own view a *thing* is simply a unity of micro-movements. The "material" elements of which a thing is composed remain invariant for the particular complex into which they enter. The "permanence" of substance—as we have previously argued—arises from the fact that when a group of random movements (of atoms, for instance) is organized into a new "stuff" (for example, molecules) the thing retains an integral value with respect to the frame of reference from which it is viewed. As Dr. R. H. Wheeler says, the public time of the whole is transposable across the parts. Every unitary behavior-complex expresses the "central tendency" of a statistical configuration of elements, which, in their range of activity, vary within narrow limits about a mean position. The doctrine that any "thing" is a kind of statistical constant of high stability is now of special importance in chemistry, where elements formerly supposed to be simple (as mercury) are known to have several forms, and the element is really a statistical average of several isotopes.

In accordance with the foregoing view, we may speak of electrons, protons, etc., as first-order objects, atoms as second-order objects, molecules as third-order objects, and so on. The term "continuant" has also been used to refer to these types of objects; thus, in molecular phenomena the atom is a continuant. But in radioactive transformation even atoms may cease to be continuants. Whether, in this case, the electrons still remain continuants is not absolutely certain.

III. The Problem of Integration

To account for the most characteristic feature of nature, we must be able to explain why it is that matter aggregates into more complex units (continuants) that, for a time, retain a relative individuality, but that nevertheless are dynamic equilibria so unstable as to be continually integrating and disintegrating under the stresses of internal and external agencies. May we apply the principle of the "survival of the fittest" in the field of inorganic phenomena and suppose that electrons and protons, and aggregates of atoms and molecules, also face a "struggle for existence"? In that case some aggregates will be sucked under in the onward

sweep of inorganic evolution, and in other cases, where the lines of advance are sustained, there will be an integration into more complex (but still unified) aggregates leading onward to the higher continuants of crystals, organic compounds (like starch) and the protoplasms.

At the lowest physical level, instability, the inherent restlessness of nature, is the result largely of mutually interacting parallelograms of force, canceling and compounding velocities, continuing through an indefinite expanse of space and time. But on this level, as just indicated, we are dealing largely with *resultant* effects only. The real problem takes its origin in the situation that may be stated as follows: Granted that electrons and protons have attained the status of corpuscular "electronicity," why should they "aspire" to the level of atomic behavior? And how did the microscopic activities of atoms ever get unified by a macroscopic rhythm which summarized the random behavior of atoms into that mode of events having the property of "molecularity"? And we might continue to raise the same question at each level of nature where evolution takes a new turn.

A once-favored mode of explanation (now regarded as a form of obscurantism) proceeded by invoking a special force or "principle" to perform the necessary function. We no longer attribute the action of a soporific to its "dormific" powers, but we still hold that aggregates of matter, like a globule of mercury, tend, under the influence of "cohesive forces," to assume a geometrical form in which the external bounding surface is spherical in shape because the sphere has the mass-surface ratio at a maximum. Thus, we argue, arises the property of surface tension, in which the outer membrane or layer of molecules acts as a tight "skin." Another attractive explanation, similar to the preceding, may be set forth as an illustration of what is still considered as a valid type of theory.

If one takes a number of balls and arranges them in various possible geometrical patterns, it will be found that there is no possible arrangement of spherical objects in space loci that will yield both maximum density and universal symmetry. Nor have the physicists ever found an equation to describe such a configuration. With these facts as a premise, one might arrive at the facile conclusion that "matter," or "behavior-stuff," is active because it is

eternally being forced to seek to attain a status of equilibrium between density and symmetry that is geometrically, and hence physically, unattainable.

This is perhaps as good an explanation as can be given at present. Certainly when one considers that the same formula, that the attraction varies inversely as the square of the distance, holds for magnetic attraction as well as for gravitational pull, and that this same geometrical relationship underlies the variation of intensity of light and sound with variations of distance, we are forced to admit that geometrical relations are most important. Indeed, the argument set forth in the present chapter affirms that integration and disintegration are aspects of a self-contained, curvilinear, or spatially closed universe, and in that sense the geometrical relations between a sphere (or hypersphere), its radius of curvature, and the contained mass, which is the basis of inverse-square laws, is a causal factor in the synthesis of behavior-stuff. Nevertheless, the proper scientific attitude seems to be that of insisting that the forces of integration are still to be revealed. It is doubtful whether we can attribute causal efficacy to mere geometrical relations or mathematical abstractions, and I therefore urge that cohesiveness must be sought in the energy-flux created by the stresses and strains of interlacing fields of force of the constituents of the total situation.

IV. Matter and Energy

Two conceptions stand out in classical mechanics. These are the doctrines of the conservation of matter (mass) and the conservation of energy. It will be recalled that W. Ostwald attempted to set aside the dualism of matter and energy in his *Naturphilosophie* of energetics. But Ostwald's system fell to the ground when electrons were discovered, for his view excluded a corpuscular physics. None the less, the contemporary physicist, in replacing the particle-picture with wave mechanics, seems to be reconstructing the theory of the physical universe somewhat along the lines of Ostwald's energetics.

One of the most interesting developments of modern physics is the overthrow of the older doctrine of the conservation of matter. Theoretical physics now tells us that energy is the sole reality of nature. The experimental justification for casting overboard the formerly sacred idea of the conservation of mass was found

when it was shown that mass is a function of velocity, and is not invariant under all conditions. In the field of relativity "mass" appears as a special kind of energy. Matter can be transformed into energy, and energy can manifest itself as mass. Indeed, this reciprocal relation between "matter" and "energy" reminds us of those South Sea Islanders who are said to make their living by taking in each other's washing!

Other consequences equally surprising flow from this remarkable picture of the universe which physics and astronomy reveal. If a body absorbs a quantity of energy E, the body behaves as if its mass were increased by the quantity E/C^2, where C is the velocity of light (though it must be remembered that the measurement must be made from a system at rest with reference to the body under observation). If a body delivers up energy, its mass is decreased by E/C^2. The relation between inertial mass and energy is given by the equation $m = E/C^2$. *All* mass is energy, and the energy stored up by any body is mC^2. This value is great because C, the internal or intra-atomic energy, is so large; so that for all practical purposes alterations of energy through radiation or absorption are negligible so far as mass is concerned. According to the older (classical) physics, or the mechanics of the Newtonian world-machine, the sphere of action of matter is constant (that is, is independent of velocity), though it varies inversely as the square of the distance. But now Newton's law must be regarded as expressing the attraction of energy by energy, and allowances must be made for the variations of mass which accompany the variations of velocities of bodies measured with respect to the absolute velocity of light.

The foregoing discoveries call attention to the fact that (in addition to the distinction between potential and kinetic energy) energy may be said to exist in two forms: it may be "bound" as in matter, or aggregates of positive and negative electricity, and it may be "free" as in radiant energy, such as light. Does this imply that light can be converted into "matter," and vice versa? One would hesitate to indulge in such speculations, if one did not already have the sanction of seriously minded physicists. Thus several physicists have supposed that such a transformation of matter and radiation accounts for the intense radiation of light-energy from the stars. I do not know who was the first to propose this idea, though certainly one of the earliest investigators to

entertain this suggestion was Professor W. D. MacMillan, who argued[6] that the energies of the stars and the sun are derived from the consumption of their own masses, while new atoms are generated in the depths of space through the agency of radiant energy. In other words, radiant energy cannot disappear into the blackness of the night skies, the nothingness of the fine structure of space, but must sooner or later reappear in the internal energy of the incarnated atoms. Or as Professor R. A. Millikan says, "The Creator is still on the job," for Millikan holds that the much-studied cosmic rays are the "birth cries" of matter being born out in space! Thus does modern Occidental science in its own lingo repeat the "mysticism" of the ancient Oriental image of eternity—a serpent swallowing its own tail.

This *samsara*, or matter-energy cycle of modern physics, is aesthetically repulsive to some—those who do not care for the inane repetition of the doctrine of eternal recurrence, which may have contributed to the development of insanity in Nietzsche. But certainly from a scientific viewpoint there is much to be said in its favor. To see this, let us return for a moment to Newton, who showed that the force of attraction F between two material particles of mass m_1 and m_2, separated by the distance d, is given by the equation, $F = G\,(m_1m_2/d^2)$. This law, which now states the attraction of energy by energy, expresses a relation independent of the qualitative nature of the bodies attracted. For gross (macroscopic) bodies, the inner electrical charges (masses) are balanced. But the same geometrical relation underlies the force of attraction (or repulsion) between two charged spheres and is given by Coulomb's law, $F = \pm K(m_1m_2/d^2)$. Here again the force acting varies inversely as the square of the distance. In general form, $F \propto 1/r^2$, where r is the distance between the poles. This relation, we have already noted, also underlies the variation of intensity of light and sound with distance. That is, $I/I_1 = r_1^2/r^2$.

It therefore appears that in the law of attraction of bodies for each other and the law of the radiation of energy, we have two laws of similar form governing opposite processes. On the one hand "radiation" tends to spread outward in spherical waves toward the outermost reaches of space; on the other hand, "matter" tends to fall together in accordance with the law of gravitational

[6] Cf. "Some Mathematical Aspects of Cosmology," *Science*, Vol. LXII, 1925, pp. 121 ff. This is not the first occasion on which Dr. MacMillan presented this idea.

attraction. As Sir Oliver Lodge has said, the energy of matter comes from an unknown source and proceeds into space toward an equally unknown destiny. If the source and the skin could be linked together, we could understand where the energy of matter comes from and where it goes to, and why the universe hasn't run down long ago. It is precisely this possibility of the reciprocal convertibility of matter and energy that some years ago led Sir Oliver Lodge[7] to pose the question: If the stopping of the motion of an electron generates a wave of light, does this mean that when a ray of light is stopped it generates an electron? Is it possible, Sir Oliver asked, that radiation is a halfway stage between ether and matter? The trouble with Sir Oliver's suggestion—aside from the fact that he does not give us any clue as to the mechanism of such an interaction—is that relativity physics no longer believes in the ether to which Lodge subscribes. And even if we substitute the electromagnetic field for the ether of space, we still face a great difficulty. If an electron is to be considered as a sharply delimited sphere wherein the electromagnetic energy, or density of the field, is concentrated, we still have the problem in a "monistic" physics of explaining why these "boundary singularities" should appear. Various attempts have been made, and are still being made, to construct "matter" out of a physics of the field, and these we shall consider in the next chapter. Before leaving this interesting subject, however, we must conclude this discussion by considering the bearing of these issues upon the general problem of integration.

V. The Cosmic Field

We now return to the previous and all-important question of why the aggregates of bound energy we call matter emerge. Why any particular type of object, or combination of previously existing units of electrical energy, should occur might be explained in the following way. It was previously pointed out that there is a very intimate connection between matter and the field of energy in which it is embedded. Let us therefore postulate that matter is a product generated in a field of force, which propagates a radius of activity in accordance with the mass m. The sphere of action of material bodies is defined by its field, $m/4\pi r^2$. In accordance with

[7] Cf. "The Aether and Electrons," *Nature*, Vol. 112, 1924, pp. 185–192.

its field of influence, each material aggregate tends to alter the total effect of the constituent fields of force in such a way that the unattainable equilibrium between maximum density and universal symmetry is at least approximated. In the field of micro-physics, as G. N. Lewis points out,[8] this is illustrated by the fact that all processes occur in such a way as to increase the net amount of conjugation, where by conjugation is meant the partial neutralization of the molecular magnetic fields. Electrons, Lewis states, conjugate to produce a couple which is self-contained magnetically and possesses little residual magnetic field. Now, if it be true that there is some relation between micro-physics and macro-physics, between the smallest length in nature, the radius of the electron, and the largest length in nature, the diameter of the universe, we must seek the explanation for integration in the cosmos as a whole. The statement that action is the curvature of the world then means that the whole space-time continuum, or the cosmic field of energy, is implicated in the synthesis of behavior-stuff.

The precise relation between the cosmic unit of action and the electronic unit of action is still a matter for conjecture. Since energy is stored in the space we call the field, it may be defined as the impulse directed toward changing spatial position. But space itself is limited; we are living in a finite, though unbounded, universe. And since matter is always on the move ("rest" being a zero case of motion with respect to some chosen frame of reference), and since there is a reciprocal relation between matter and the field, matter can consequently move (in an absolute sense) only in the direction of building up higher unitary modes of behavior (atoms, molecules, crystals, protoplasms, etc.) in the cosmic field. Evolution, therefore, is a movement toward higher modes of behavior that express the necessity for organizing whirls of micro-events into the unitary macro-events which have been termed macroscopic rhythms.

If we think of the moving electrified points we call electrons and protons as knots in the continuous threads which spiderweb all space (or as the ends of Faraday tubes of force), evolution then becomes a process of tying energy knots in the field. The process of physical integration is one whereby these strings become

[8] See his book, *Valence and the Structure of Matter*, 1923, p. 153.

twisted up into ropes Accordingly, objects differ as they tangle or untangle more or less filaments of energy. The more the "free" energy of space is bound up, the more complex the "thing" becomes. On the whole, the process of assimilation may be compensatory to the process of dissimilation, so that if the universe is "running down" in one corner of space-time (perhaps in accordance with the second law of energetics), it must be "running up" somewhere else (perhaps in accordance with the first law of energetics). This may appear like wild speculation, but if it does, recall that it is a direct application of the hypothesis of the mutual conversion of matter and radiation which various theorists have proposed. Further confirmation might be claimed in P. Du Val's statement[9] that "The world-lines of all objects which compose the earth, including the bodies of sentient observers on its surface, form a sort of rope of myriads of strands, indefinite (probably infinite) in length and roughly constant in thickness, twisted (since the earth as a whole rotates) and matted—on the surface at any rate—to an indescribable complexity."

In this manner the theory of relativity may be used to lend support to the theory that the cosmic field of energy is active in the synthesis of matter. The plausibility of the argument rests on the assumption that the universe is a self-contained manifold, and that the density of matter is so averaged that the matter of the universe is spread uniformly over immense space.[10] Just as, for many purposes, a homogeneous medium may be substituted for an assemblage of atoms or molecules, so Einstein substitutes for the granular structure of the universe (where the grains are not only planets, but stars, nebulae, and similar giants) a macroscopically homogeneous distribution of matter. Thus, as assumed in our explanation of the uniformity of nature, the curvature of space is only approximately constant and isotropic, deviating here and there, within and near condensed matter. In the earlier estimates of the size of the universe, based on rough estimates of the average density of matter (some thousands of suns per cubic parsec), Dr. Silberstein postulated a radius of curvature not smaller than 10^{12} astronomical units. Thus the mean density of matter has a small

[9] Cf. "On the Discrimination between Past and Future," *Philosophical Magazine*, Vol. 49, pp. 379-390.

[10] I am here indebted to Dr. L. Silberstein's discussion in his book *The Theory of General Relativity and Gravitation*, 1922, pp. 130 ff.

value because it is proportional to the radius of a world which was believed to be very great, though still finite. However, these estimates are constantly being revised, especially now that we are living in an "expanding" universe, the radius of which varies with time!

With all this as a background, we once more raise the question: If it be true that the activity of individual elements within an aggregate is due to their seeking to attain a macroscopically symmetrical magnetic field, and if, furthermore, there is any relation between the atomic unit of action (Planck's constant) and the cosmic unit of action (the cosmical constant), does this not imply that the universe as a whole constitutes a cosmic field which controls the emerging series of types of continuants arising within the movement-continuum? If this be true, then not only is gravitation an expression of the effort of the universe to straighten itself out, as Professor Whittaker puts it, but the course of physical evolution is also a revelation of this same fact. In somewhat different language Eddington says the same thing when he declares[11] that the laws of material structure have reference not to the constitution of an empty continuum, but to the specific collection which aggregates must take up in order to adjust themselves to equilibrium with the surrounding conditions of the world. If we adopt the language of gestalt theory, we may observe that it looks as if the universe is in a bad "shape"; but, paraphrasing Leibniz, we might also argue that it is in the best of all possible shapes, considering what it is up against!

[11] Cf. *The Mathematical Theory of Relativity*, by A. S. Eddington, p. 153.

CHAPTER ELEVEN

THE PHYSICAL WORLD: THE PARTICLE PICTURE AND WAVE MECHANICS

The past and future meet and mingle in an ill-defined present. The passage of nature which is only another name for the creative force of existence has no narrow ledge of definite instantaneous present within which to operate. Its operative presence which is now urging nature forward must be sought throughout the whole, in the remote past as well as the narrowest breadth of any present. Perhaps also in the unrealized future.

—A. N. Whitehead

The materialistic conception of the electron is that it must be treated as something given a priori, i.e., as a foreign body in an electromagnetic field, which is a reality of a different category.

—Hermann Weyl

I. Recapitulation: Matter and the Field

In developing the philosophy of a monism of action, the as yet unresolved and perhaps ultimate dualism of physics, the dualism of *matter* and the *field*, has supplied the pivotal concept. We have sought to portray this dualism as the bottommost homologue of the pervasive relationship—which appears on all levels of nature—between the static and the dynamic, the structural and the functional aspects. In other words, in the present conception the dualism of matter and energy, of protoplasm and life, and of body and mind, are only special cases of the relation between electrons-protons (as particles) and their electromagnetic fields of energy. The material organization of the universe expresses the static, that which has already been accomplished and functions in accordance with what constitutes the "mechanical" aspect of nature. But in addition to mechanism and standardization there is also variability, the movement toward the future, the striving toward higher behavior-complexes. This tendency toward novelty in-

troduces variability and unpredictability into nature, and it is in this discontinuity with the past that new forms of behavior take their origin.

Popularizers of the theory of relativity have familiarized us with the relativistic view of the world as a four-dimensional space-time manifold, the geometry of which describes the history of material particles as observed visually. Into this four-dimensional "tensorial construct" we human beings have introduced the element of change by our resolution of the components of the world into the rectangular co-ordinates of cartesian geometry and the independent axis of time. According to the relativists, it is this arbitrary (human) time dimension which stratifies the universe into the static and the dynamic.

Without specifically telling us how "energy," with its properties of mass and inertia, can be converted into what we know as "matter," relativity theory asserts an equivalence between them and translates the older doctrine of the conservation of matter and the conservation of energy into the new and more general principle which may be termed the conservation of the "world impulse." Mass, as a Newtonian invariant, is not conserved; it is the total quantity of mass and energy that remains constant. True, there has been some question as to whether the *geodesics* which bodies follow define a minimal principle or a maximal principle of action. In ordinary mechanics the physicist pictures the motion of bodies as a linear relation between the co-ordinates of space and time. This is a straight line in the geometry of cartesian co-ordinates. The exact form which this demand that bodies shall move in minimal lines should take in theory of relativity is not completely settled. The problem is to translate the restriction that $\int ds$ be a minimum (that is, $\delta \int ds = 0$) into terms of geodesics in the non-linear equations of the general theory of relativity.

Now the physicist knows that under certain conditions the ideas of "straightest" and "shortest" coincide. This is true in the theory of curved surfaces. In conformity with the "impulse energy tensor" of relativity theory, a particle takes the "line of least resistance" in the sense that the trajectory it traces out in its motion expresses the geodesic of that manifold. If the time-path of a particle be considered as a fourth co-ordinate of the metric manifold, this world-line will, in its most general form, be repre-

sented by the arc of a great circle traced through the curvilinear universe. *Action*, therefore, is conserved because action is related to the curvature of the world; energy cannot wander off to infinity, because we are living in a spatially closed (finite but unbound) universe. Thus in this beautifully simple scheme of relativity theory we have at least a partial fulfillment of the vision of Riemann and Einstein: a uniform formulation of all the phenomena of physics.

However, the universe is not so simple as a pure continuum posits. Somehow we must derive the property of discreteness, for which what we call "matter" is only a name. Relativity theory assumes the existence of matter as a fact, and does not deduce its existence from the field equations. If, following Minkowski, we start with a system of world-points, we may suppose that they generate world-lines, and extending this idea, we might then (as noted in the previous chapter) view the history of the world as a result of the progressive tangling up of world-lines. These latter, however, cannot be regarded by the physicist as abstractions or limiting ideas of the pure space-time continuum; for the physicist they must be treated as physical actualities. Herein lies the problem and domain of physics as contrasted with the field of pure mathematics.

In connection with this general problem of whether "matter" represents something more than the geometrical distortion in a spatiotemporal matrix, even Bertrand Russell, who in general has no use for the "mysticism" of emergence concepts, points out[1] that in so far as the existence of electrons and protons cannot be deduced from the general theory of relativity, materiality will have to be regarded as an emergent characteristic of certain groups of events. No matter in what form we take it, the problem of matter is still with us: we cannot deduce its existence from "chrono-geography" (Russell), or the "substance-action of electricity" (Weyl), or the "material-energy-tensor" (Eddington), or the "electrical density of a configuration-space" of wave mechanics.

Our own "solution" to this problem has been this: unlike Einstein and other physicists, we do not attempt to deduce the existence of matter from a prior framework of a space-time con-

[1] Cf. *Philosophy*, 1924, p. 287.

tinuum; and unlike such philosophers as Alexander and Whitehead, we do not regard matter as a whole as an emergent from a prior matrix, space-time Matter is one member of an eternal trinity, the space-time-matter universe. This, however, does not prevent us from thinking of the emergence of particular discrete particles, if we mean by this the conversion of some of the "infinite eternal energy" of the world-fabric from a radiational into a corpuscular state What really comes closer to our own view is the idea that this problem is insoluble in terms of the traditional Aristotelian "laws of thought" But before taking that up, let let us see how far we can go with the present physical theory, before parting company with it.

II. Least Action and Wave Mechanics

Throughout the history of physics there has been a kind of intuitive search for a minimal principle in nature. This search for a principle of least action may reflect the fact that man appears to take the line of least resistance in moving toward his goals. Whatever the subjective origin for such a demand, the first clear formulation of a minimum principle applied to objective nature is apparently to be found in Hero of Alexandria (about 250 A.D.), who presented the remarkable theorem that when light from an object is reflected from a mirror to the eye, the path of the ray of light between the object and the eye is a minimum. Hero was concerned with the reflection of light, and it was to be expected that someone would then apply the same idea to the refraction of light. This was attempted later by Snell, who formulated a law that was rediscovered by Descartes. The next development, therefore, appears in connection with the work of Descartes (1596–1650). In endeavoring to improve the shape of a lens, Descartes discovered an interesting curve that led to further research in geometry along these lines.[2] These are the earliest beginnings of the principle of least action, which was subsequently to be generalized by Hamilton into a universal principle of dynamics and still later to be taken over by relativity physics and wave mechanics as the supreme principle of all physical science.

This entire movement of thought is one of the most interesting in the history of science. Unfortunately many physicists do not

[2] Cf. *The Great Mathematicians*, by H. W. Turnbull, p. 74.

recognize the extent to which present formulation of physical doctrine is determined by the historical evolution of physical philosophy. It is especially true—as we have already said—that modern scientists do not sufficiently appreciate the importance of the interaction between the views of Descartes, Leibniz, and Newton with the subsequent triumph of Newtonian physics. Let us recall the relevant facts, since a knowledge of them is essential to an understanding of the situation.

Descartes, as we all know, attempted to lay the foundations for a completely mechanical theory of the physical world. In doing so he invented cartesian co-ordinates, and thus laid the basis for analytical geometry and the Newtonian mechanics. In his law of falling bodies, as given in the statment that the product of mass by velocity is constant, Descartes presented a noteworthy formulation of the fact of the conservation of the quantity of movement. The thing here which is of particular interest is the way in which the mechanical conceptions of Descartes reappear in Newtonian physics. Following the Cartesian view of the quantity of motion, or "momentum," as fundamental, Newton arrived at force as a "primary magnitude." In the dynamical theory of Newtonian physics, the concepts of force, mass, and momentum are the basic categories.

It is also generally known that there was considerable rivalry between Newton and Leibniz. But knowing Newton's religious motivation, one can fairly assume that had Newton been able to foresee the inevitable logical consequences of his mechanical doctrine in the godless universe of Laplace, he would have been constrained toward a more hospitable regard for the views of Leibniz. The Leibnizian effort at a reconciliation of the mechanical universe of Descartes with a teleological view of nature rests upon Leibniz's reinterpretation of the notion of "substance" (or Cartesian *extension*) in dynamical terms. If Newton had followed Leibniz, as Huygens did, work, mass, and energy (Leibniz's *vis viva* is really "kinetic energy") would have become the primary categories of classical physics.[3] But even though, as Bertrand Russell points out in his *Critical Exposition of the Philosophy of Leibniz*, several types of dynamical theory were confused by Leibniz, nevertheless Leibniz's formulation of the law of motion

[3] Cf. *A History of Physics*, by F. J. Cajori, 1899, pp. 52–53.

as proportional to the square of the velocity has adapted itself more readily to the purposes of physics than the (above) law of Descartes. Moreover, Leibniz, probably as a consequence of his knowledge of optics and his acquaintance with the principle of Fermat (that a ray of light minimizes the time-passage between points in space), began to speculate about a minimization principle in nature, and his views in this field were to become influential a little later, as we shall see in a moment.

After the early investigations into variational principles, which we have just referred to, Maupertuis (1698–1759) turned his attention to the subject and formulated his principle of least action. Thus this investigator, who was early given over to speculation as to what grounds the Creator had for preferring the law of inverse squares to all other possible laws of attraction, deserves credit for the first explicit enunciation of this principle.[4] It must be noted, however, that in formulating this principle Maupertuis was not altogether original. He was much influenced by Leibniz's idea of making nature invariably work with a minimum of action. He states that light takes neither the shortest path (Hero, Snell) nor the path which it describes in the shortest time (Fermat), but the path "*for which the quantity of action is least.*" The quantity of action is taken to be the product of the mass of bodies times their velocity through the space they traverse. In this way, as Whitehead puts it,[5] Maupertuis develops the idea that the paths of particles "must achieve some perfection worthy of the providence of God." Thus, in the case of Leibniz and Maupertuis, we find a theological motive so deeply embedded in their thinking that we may well say that for these Continental thinkers physics has a metaphysical basis. The laws of mechanics not only bear witness to the wisdom of the Creator, but prove that this is the best of all possible universes! (It is very interesting to contrast the idea of Maupertuis, that following the principle of least action testifies to the wisdom of God, with the later idea that the doctrine of the conservation of movement dispenses with the necessity of God.) This full-blown optimism of the theologizing physicists was later to provide the occasion for much ridicule

[4] At this point I am following the excellent volume *The Principle of Least Action*, by P. E. B. Jourdain, 1913, *passim*.

[5] Cf. *Science and the Modern World*, 1926, pp. 89–90.

on the part of Voltaire, but as N. Wiener points out,[6] the applications of these ideas have proved to be anything but fatuous, for the idea of representing the laws of physics by principles of minimization is the source of the mechanics of Lagrange and Hamilton, from whom the line of inheritance to Heisenberg and Schrödinger (wave mechanics) is clear and direct.

Another line of investigation results in a somewhat different way of expressing the principle of the economy or conservation of motion Already in 1738 Daniel Bernoulli had turned to the impact of moving particles for the explanation of the pressure of gases. This kinetic theory was extended by later physicists. The doctrine of kinetic energy, applied to the behavior of particles (molecules), is the prelude to the principle of the conservation of energy. Newton suspected the presence of the principle of the conservation of energy in mechanics, and Rumford had maintained the universality of the laws of energy. But Joule and Mayer established the particular principle of the equivalence of the amount of heat produced and the amount of mechanical energy destroyed. In other words, the principle of the conservation of energy finds its empirical verification in the discovery of the mechanical equivalent of heat. The next step was to show that although this principle of the conservation of energy is not identical with the previously developed principle of least action, it can be derived from it because the least action principle is sufficiently general to cover it. The relation between the two is brought out clearly by Max Planck in these words:[7]

As an illustrative example, let us consider the motion of a free particle under no forces. According to the principle of the conservation of energy, such a particle moves with constant velocity, but nothing is said concerning the direction of the velocity, since kinetic energy does not depend on direction. The path of the particle could, for example, be rectilinear or curvilinear. On the other hand, the principle of least action demands, as we shall show in detail below, that the particle must move in a straight line.

The reason for the difference in the results derived from the two principles lies in the fact that when applied to any problem, the principle of

[6] *Philosophy of Science*, Vol. I, 1934, p. 482.

[7] Cf. *A Survey of Physics*, p. 110.

the conservation of energy furnishes one equation only, while it is necessary to obtain as many equations as there are variables in order to determine the motion completely. . . . Now the principle of least action furnishes, in every case, as many equations as there are variables.

Eventually this doctrine that nature is economical in her activities achieved the form in which W. M. Hamilton puts it at the beginning of the nineteenth century. By assuming that the energy of a dynamical system consists of two portions, the kinetic energy T and the potential energy W, Hamilton arrives at the formula of the conservation of energy as expressed thus: $T + W =$ constant. In this form the principle of least action asserts that when a system passes from its state at one instant of time t_1 to the state at a second instant of time t_2, the sequence through which the system passes is such that the mean average value of the difference between the potential and kinetic energies during the interval of time of change will be a minimum. Mathematically the principle appears in this form:

$$\delta \int_{t_2}^{t_1} (T - W)\, dt = 0.$$

Thus, through the co-operative efforts of Leibniz, Fermat, Maupertuis, Lagrange, Hamilton, and later Gauss and others, the doctrine of the conservation of movement, the "mother of analytical mechanics," becomes a general principle of dynamics. The philosophical importance of this conception cannot be stressed too much, as is quite obvious, for example, in wave mechanics.

It is at this point that the older classical physics makes contact with the newer physics. After the interesting life-history we have just sketched, the law of least action is now extended to embody a synthesis of optics and mechanics through an analogy with the theory of minimal optical path. This minimal principle, in other words, applies to both radiational phenomena and the behavior of particles, and the close similarity is indicated by the equations of motion of light rays and material particles in space-time:

$$ds = 0 \qquad \text{(for light rays)}$$
$$\delta \int ds = 0 \qquad \text{(for particles)}$$

Here, as Schrödinger points out,[8] "it seemed as if Nature had effected the same thing twice, but in two different ways—once, in the case of light, through a fairly transparent wave-mechanism, and on the other occasion, in the case of mass points, by methods which were utterly mysterious, unless one was prepared to believe in some underlying undulatory character in the second case also." This, of course, is precisely what wave-mechanics, the undulatory theory of matter, is committed to—"some underlying undulatory character" in the case of mass points.

The synthesis here would be much less impressive if it represented only a speculative venture. But such an undertaking was absolutely essential to the recent course of experimental investigation. The background here has been well stated by Karl K. Darrow in the following words:[9] "We may reflect that twenty-five years ago it was universally supposed that light possessed only the qualities of a wave-motion; and then experiment was piled upon experiment which showed that in addition it behaves in many situations as though it were a stream of corpuscles. Perhaps we stand at the beginning of an equally imposing series of experiments, which will show that matter with equal inconsistency partakes of the qualities of particles and of the qualities of waves."

At first the onrush of experimental results to which Dr. Darrow refers was very disconcerting, but eventually the step linking waves and particles by common properties was inevitable. For as C. J. Davisson has pointed out,[10] with the passage of time it became obvious that if the problems created by the distinction between matter and radiation were to be solved, it would be necessary to formulate a new system of mechanics that would degenerate into ordinary mechanics in the case of gross systems, but that was also applicable to systems involving electrons and protons. The original suggestions toward such a synthesis came from Louis de Broglie in 1924, when he advanced the conception of "material waves," and showed that every mechanical phenomenon may be

[8] Cf. *Science and the Human Temperament*, 1935, p. 173.

[9] Cf. "Introduction to Wave Mechanics," *The Bell System Technical Journal*, Vol. VI, 1927, pp. 653–701.

[10] See the article "Are Electrons Waves?" *Journal of the Franklin Institute*, May, 1928.

treated as a wave phenomenon. About a year later Erwin Schrödinger and Werner Heisenberg developed these analogies into theories which are fundamentally equivalent, and since that time the most important addition to the fundamental structure of the new quantum theory has been made by P. A. M. Dirac.

Although little has been added since the latest contribution by Dirac (except for the more recent cosmological speculations of A. S. Eddington), this does not mean that physics has at last attained a final state of completeness and perfection There are still various unsolved problems, and it is likely that in the future new "unified field theories" (Einstein), attempting to combine relativity theory and quantum mechanics, will be forthcoming. There will be renewed efforts to remedy the defects of old theories or to invent new theories that will avoid those difficulties. Among such possibilities is the return to the ideas of Faraday, in the hope of developing his ideas of lines and tubes of force in such a form as to provide the desired synthesis of the particle- and wave-pictures of nature.

Because of the possibilities in this direction, we now turn to an examination of the line of speculation.

III. Quantum Tubes of Force

It has been stated that the ultimate dualism of nature is that of matter and the field. In the previous pages we have seen how relativity theory and wave mechanics have sought to overcome this dualism. Now we consider another effort at bridging this hiatus: the theory that may now be designated by the term "quantum tubes of force." Let us survey briefly the historical development of this concept.

The first person to consider at some length the dualism of matter and the electromagnetic field was Michael Faraday, who invented the theory of electric and magnetic tubes of force.[11] The next development of Faraday's electromagnetic theory was provided by Clerk Maxwell, who made precise the distinction between matter and the field of energy. Maxwell's famous equations of electromagnetism, couched in terms of the calculus and therefore emphasizing the continuity of field processes, were devised to express the manner in which electromagnetic radiations were

[11] See his "Thoughts on Ray Vibration," *Philosophical Magazine*, May, 1846.

propagated through ether, or space free from matter. (This pioneer work of Maxwell, supplemented by that of Heinrich Hertz, provided the theoretical foundation for wireless telegraphy, or radio transmission) From the dualistic viewpoint of Faraday and Maxwell, matter might therefore be defined as the region in which Maxwell's equations do not hold; a particle might even be defined as a hole, or a vortex, in the ether of space.

This view of radiation as a species of vibration in the lines of force which are supposed to connect particles and masses together has been extended by E. T. Whittaker,[12] who regards discrete quantum tubes of force as physical realities. Electromagnetic and luminous radiations are of the same kind, the only difference being in the length of waves. Professor Whittaker's four-dimensional tubes of force include as special cases both kinds of Faraday tubes. In discussing the properties of these discrete tubes, Whittaker has tried to make the point that such tubes would satisfy all the demands of relativity theory, would yield electric and magnetic vectors at right angles to each other, and would provide a geometrical integration of the Maxwell-Lorentz equations of the electromagnetic field.

This view has secured additional support from the fact that Sir J. J. Thomson has also lent it his approval. In Sir Joseph's view an attempt is made to retain the essential of the wave theory (to account for light interference effects) and at the same time meet the requirements of quantum phenomena, such as the photoelectric effect. He therefore assumes that the energy of the wavefront is not uniformly distributed over it, but is concentrated in such a way that it has a "speckled" structure. This concentration is attributed to the fibrous structure of the ether, so that a nucleus of radiant energy or a quantum travels as a kink along the ether-fiber, regarded as a tube of force extending between the source and sink. According to this view, an electron is simply the end of such a tube of force.

The theory that the ether possesses a fibrous structure, with the electromagnetic energy traveling along Faraday lines of force conceived as actual strings extending through all space, has been attacked by R. A. Millikan in his book *The Electron*. Aside from

[12] "On Tubes of Electromagnetic Force," *Proceedings of the Royal Society of Edinburgh*, Vol. XLII, 1921, pp. 1–23; see also H. S. Allen, "Aether and the Quantum Theory," *Ibid.*, Vol. XLI, pp. 34–43.

other difficulties that he points out, Millikan believes that it encounters trouble when it attempts to visualize the universe as an infinite cobweb whose threads never become tangled or broken no matter how swiftly the electrical charges to which they are attached may be flying about. But in spite of the objections to the ether-string theory, Professor Thomson continues to hold to the notion of tubes of force in a filamental ether [13] It is especially interesting that Sir Joseph has not abandoned this view since the advent of wave mechanics, or the undulatory theory of matter. Basing his views in part on the experiments of his own son, G P. Thomson, Sir Joseph points out that a moving electron is a much more complicated thing than a small point charge in motion. A moving electron is always accompanied by a series of waves, and these waves have complete control over its path.[14] *The statement that the electron provides its own ether in the form of these waves* is very significant, for it emphasizes the fact that fields or tubes of force are still required in physics, whether it be relativity physics or quantum physics. Prior to the acceptance of wave mechanics, Sir J H. Jeans also lent this view his approval when, following the suggestion that a tube of force may link the electron and the proton together, he surmised[15] that the atomicity of h (Planck's quantum constant) may arise from the atomicity of $4\pi e$, the strength of the tubes of force connecting a nucleus to an electron, for the value of h, which is given by the equation

$$\frac{hc}{2\pi} = k(4\pi e)^2$$

is not far from unity.

Of course, in none of these foregoing views is there a serious attempt to make any general philosophical applications of these ideas. It has remained for A N. Whitehead and the gestalt psychologists to make use of the more general implications of "field physics." It is difficult to understand and harder to explain Dr. Whitehead's views, and fortunately it is not necessary to undertake that here. But when Whitehead interprets Faraday's electromagnetic tubes of force as streaming through space and

[13] See his paper "A Suggestion as to the Structure of Light," *Philosophical Magazine*, Vol. 48, 1924, pp. 737–746.

[14] See his little volume *Beyond the Electron*, Cambridge University Press, 1928.

[15] *Atomicity and Quanta*, 1926, pp. 92 ff.

time, in the belief that the theory of action at a distance and action by transmission through a medium are thus reconciled, he gives us a fertile suggestion. In this view the field sustains the relatedness of things and provides the basis for the uniformity of nature—hence our present interest in Dr. Whitehead's doctrine. Spread through a spatio-temporal region, the field modifies the "ingression" of objects into nature. Thus a physical object, such as a mass particle or electron, expresses the character of the future so far as it is determined by the happenings of the present. With these dicta before us, it is quite clear that Dr. Whitehead has surrendered the last vestige of materialism in his own thinking.

IV. Conclusion

In the foregoing pages we have seen the human mind struggling with one of the most difficult problems it has ever posed. In a sense the existence of matter in space is a mystery, an inscrutable riddle the unraveling of which will solve the problem of the infinite divisibility of matter and the size of our expanding universe. Whatever theory physics eventually may adopt, "matter" will always have to be looked upon as a center of relations which pervade the spatio-temporal field in which it acts. Thus we must from now on reject the naïve materialism of Newtonian physics, that "space," "time," and "matter" are objective and independent realities; space involves time and matter, and time involves both space and matter, and matter implicates, and is implicated in, space and time. Or in our own language we say that we reject the Aristotelian-Newtonian notion of "substance" as the self-subsistent underpinning of the phenomenal universe.

And this brings us to our own attitude, already indicated but here repeated, that this problem is really insoluble, at least in terms of the Aristotelian laws of thought. We do not propose to set down at length what we have stated on other occasions, and so we merely indicate our own non-Aristotelian analysis as follows:

Thesis:
(Law of Identity)

$$A = A \left\{ \begin{array}{l} \text{An electron is an electron (particle).} \\ \text{Light is a wave motion (undulatory).} \end{array} \right.$$

Antithesis: (Denial of Identity) $A \nless A \begin{cases} \text{An electron is undulatory.} \\ \text{Light is corpuscular.} \end{cases}$

Synthesis: $A = A$ and non-A $\begin{cases} \text{Electrons are corpuscular and undulatory.} \\ \text{Light is undulatory and corpuscular.} \end{cases}$

Stated in terms of the theory of emergent evolution, the above schema means this: an electron is what it is because of the universe in which it exists. There are no electrons in a universe devoid of waves, any more than there are disembodied waves in a universe devoid of particles. This means that since waves are never isolated from matter, it is the universe of matter that makes possible the emergence of rhythms, and it is the existence of rhythms, or wave-patterns, which, at certain nodal points, gives rise to corpuscles. In emergent evolution, electrons lose their identity in larger material aggregates; but in return, the universe as a whole constitutes a "comparison object" (Eddington) against which electrons can measure themselves and thus have their relative identity and individual properties determined.

Several critics of the writer have regretted the remnants of Hegelianism which they discern in the above view, but I see no escape from this. "Matter" and "radiation" are mutually dependent "parts" of a universe which is an essential trinity—a space-time-matter universe—where parallel interconversions of matter and radiation, corpuscles and waves, continue throughout time; but the precise "mechanism" of this, I repeat, is unintelligible in terms of our present modes of thinking. The limitations of the brain-mind which are connected with the process of "identification," and which make the above process "unintelligible," have already been pointed out by the author.[16]

This completes our survey of the physical situation. Now we step up a rung on the ladder of emergent evolution to deal in a similar way with the problems of life and mind. There we shall have occasion to use ideas already elaborated in the preceding chapters on the physical world.

[16] *Philosophy and the Concepts of Modern Science*, pp. 122–123.

CHAPTER TWELVE

LIFE AS A FORM OF CHEMICAL BEHAVIOR

The organism in its totality is as essential to an explanation of its elements as its elements are to an explanation of the organism.

—WILLIAM E. RITTER

I. THE ORIGIN OF LIFE

The problem of the origin of life is one of the oldest enigmas with which the human mind has been concerned; and yet it is a problem which is ever-recurring, seemingly as insurgent as life itself. Primitive man had his creation myths to account for his origin; the modern scientist has his own more recent hypotheses. But we are still seeking the magic key which will unlock the portals to the mystery of life and death.

Antiquity has bequeathed to us two classical theories of how life originated on our planet. We are all familiar with the theory of the origin of life as presented in Genesis. Here we are told that life came into the world through an act of will on the part of the Creator. This is the dualistic theory which implies that life is some sort of superphysical force or entity that enters the organism from without. This theological solution merely removes the problem from the domain of natural science and experimental method, and therefore is not an explanation that can be looked upon with favor by the biologist. The other solution that comes to us from earlier times is the one presented by the Roman poet Lucretius, who found in the theory of spontaneous generation the answer to the riddle. But Lucretius was merely giving voice to a theory already in vogue. From Aristotle down to comparatively recent times it has been believed that living organisms could originate from inanimate matter. This doctrine of abiogenesis (or heterogenesis) was not finally refuted until the work of Louis Pasteur (begun in 1860) carried to a conclusion the earlier experiments of Francesco Redi, who, in the seventeenth century, disproved the general belief that worms, maggots, and other lowly

organisms had their origin in decaying flesh. Pasteur, working with sterile water, showed that microorganisms do not originate in liquids.

Although it is true that the experiments of Pasteur and John Tyndall definitely proved that all life comes from life (*omne vivum ex vivo*) and that the doctrine of abiogenesis is false, this work does not exclude the possibility that life might once have arisen here on earth from what we call inorganic matter, after the various conditions essential to the existence of organisms were present. Chalmers Mitchell has suggested that we reserve the term "archeobiosis" or "archegenesis" for this view that life in the past might have developed from non-living matter by passing through a series of steps. What these steps might have been we can now imagine from the work of E. C. C. Baly on the photosynthesis of formaldehyde and the sugars. The more recent work of George W. Crile on *autosynthetic cells* also is relevant here.[1] Nor can we overlook the important work of Dr. W. M. Stanley on the invisible and non-living protein, the tobacco mosaic virus, that appears to constitute a bridge between the living and the dead. These are among the best guesses concerning the nature of the connection between the living and non-living that are now available. (Later on, in Chapter XXI, we shall return to this problem.)

However it originated, living matter now possesses certain properties and functions. It is these forms of behavior that enable the biologist to distinguish between the living and the non-living, for there is nothing in the mere physical appearance of dead protoplasm which differentiates it from living protoplasm. Ordinarily it is stated that growth, cell reproduction, respiration, irritability, metabolism, and motion are the distinguishing characteristics of living organisms. But W. J. V. Osterhaut, in his little book on *The Nature of Life*, abandons some of these criteria as invariable differentiating characteristics of life, and chooses metabolism and selective permeability of membranes as most fundamental. This indecisiveness concerning the essential properties of living matter may point to the fact that life was not catapulted suddenly into matter, but accumulated its modes of behavior through a series of stages in evolutionary development.

When living matter is subjected to post-mortem examination,

[1] Cf. *The Phenomena of Life*, by George W. Crile, 1937, Ch. 27.

it is found to consist of water, proteins, fats, carbohydrates, and salts. In combination and under suitable conditions, these elements give rise to what we call life. Now why is it that these elements have properties in combination which they apparently do not have in isolation? Is there, as some have asserted, a living substance, *biogen*, for which the other materials of protoplasm constitute the environment? Those who hold to this view that life involves a specific chemical substance adhere to what is called a *stuff* theory of life. The *engine* theory of life, holding that the difficulties encountered by the postulation of a specific biogen molecule are insuperable, states that life may be regarded as consisting of the mutual interactions of a mixture of substances organized in an appropriate way. According to this view there is no specific living substance. This view is in harmony with the doctrine that "life" and "mind" are not entities, but forms of behavior.

Let us now try to discern what hope there is of giving a naturalistic interpretation of these intriguing mysteries in living organisms which have seduced the vitalists into the worship of false divinities masquerading under the guise of non-biological forces and meta-empirical entities.

II. The Phenomena of Life

Those who take the position that "life" refers to the types of behavior characteristic of the protoplasms reject the dualistic theory. In defense of their view they point to the fact that as science progresses, the lines of demarcation between the living and the non-living, the conscious and the unconscious, grow fainter and fainter. The numerous analogies between fields formerly supposed to have little in common support this position. The gaps in nature are not so unbridgeable as they were once supposed to be. One of the most obvious illustrations of this, within the field of the organic itself, is the fact that protoplasm in plants is subject to the same laws as protoplasm in animals. Many other illustrations of this idea are available. Some of the phenomena of living matter that can be duplicated in the behavior of non-living systems are these: amoeboid movements, indicative of life, are reproduced in mercury globules; linseed oil exhibits "memory" and "forgetfulness" (or we might say, has a "learning curve"); metals show fatigue; fertilization can be induced by chemically

artificial means, as Loeb has shown. Again, if respiration be the taking in of oxygen and the giving off of carbon dioxide, can we not say that a gas engine "breathes"? In a word, from a monistic point of view man is simply a magnified test tube.

This may not seem to flatter human beings, but the statement itself is quite in line with the assertion of a prominent philosophical smart-aleck who declares that life is a struggle not against sin, but against the hydrogen ion!

Summing up these foregoing results, the mechanist affirms that although it must be admitted that there is no physico-chemical model at hand which is adequate to explain all the facts of living matter, in the light of what has already been accomplished the biologist may well hope that this model will be forthcoming in the future. This, at any rate, is the well-weighed opinion of Sir Charles S. Sherrington when he states:[2] "Of not a few of the living processes of the living body, such as muscular contraction, the circulation of the blood, the respiratory intake and output of the lungs, the nervous impulse and its journeyings, we may fairly feel, from what we know of them already, that further applications of physics and chemistry will furnish a competent key."

But in spite of the very fruitful applications of physical chemistry to the phenomena of living matter, and notwithstanding the promising advances in the discovery of the physical and mathematical aspects of the phenomena of organic development and behavior, there are those who hold that we shall never know enough physics and chemistry to explain all the characteristics displayed by living organisms. Let us therefore determine what grounds there are for the "pessimistic" view that we shall never be able to encompass life, that mysterious and elusive reality of the poets, within the boundaries of natural science.

One of the difficulties encountered in subsuming life processes under the categories of mechanism is this: when a mixture of substances is undergoing reactions in a test tube, these reactions progress toward a final state of equilibrium, or they go to "completion," at which point the substances possess proportions different from those that existed when they started. But in protoplasm the proportions of the mixtures remain relatively constant. The organism is a relatively stable unity of diverse chemical substances

[2] "Some Aspects of Animal Mechanisms," *Nature*, Vol. 110, 1922, p. 351.

interacting with each other. It is because the physiological activities of the organism maintain *normals*, such as the regulation of the hydrogen ion concentration, that Professor J S. Haldane argues that life itself is a unique reality. A somewhat similar problem is that of explaining how the chemical constitution of the blood stream is kept at a point approaching constancy, in the face of all the variables that influence its composition. Then there is the analogous problem of explaining the normal "mechanism of defense" whereby the body resists disease. Pathologists are still baffled by various aspects of immunity. All these facts indicate that the normally functioning organism is a complex sum of two factors, the plus (+), or those that accelerate, and the minus (−), or those that depress, both so closely interconnected that it is a wonder the organism can function as a unity at all. Here indeed is the "wisdom of the body." The general problem of regulation is that of conceiving the mechanisms whereby these processes are equated to each other.

To designate this order of phenomena, various terms have been employed, such as "organicity" and "organization." These terms refer to the fact that the whole organism seems to act in and through the unit parts, in development following fertilization, as well as in the balancing of the processes within the organism to each other, and in the adjustment of the organism to its external environment. Life is not only, as Herbert Spencer says, "the continual adjustment of internal relations to external relations"; it is also the mutual adjustment of the manifold transformations within the organism to each other.

By what sort of physico-chemical model can we picture the structure necessary to maintain and reproduce the foregoing typical forms of vital behavior? Hans Driesch, J. S. Haldane, J. A. Thompson, Henri Bergson, William McDougall, and others hold that there is no mechanical model that enables us to understand how the phenomena of growth and regulatory processes take place. In his work *The Science and Philosophy of the Organism*, Driesch has tried to show that no "constellation of parts" will explain the facts of development and restitution of parts. He therefore invokes the entelechy to perform the functions. Reinke's *dominants* were also created for the purpose of explaining the "influence of the whole on the parts." Must we agree to this?—or is there a naturalistic theory available which these men have

overlooked? Let us see what hope there is of giving a physico-chemical account of these various processes of life and behavior.

III. The Physical Chemistry of Life

Although from a monistic point of view man may be a magnified test tube, there are several differences between the reactions in a living organism and those of inorganic chemistry. These are: (1) organic reactions usually do not go to completion, as already noted; and (2) organic reactions are usually slower. Therefore we get equilibrium conditions more often in organic reactions than in organic processes. Here we have one clue to the explanation of the mysterious processes of living organisms. The problem here is to describe how, in the multiple-complex processes, the integrity of the whole is preserved. What are the integrating factors? As we have seen in Chapter V, the many chemical processes in a complex organism are not to be represented by straight-line (linear) equations. Protoplasm is not chemically a single, homogeneous substance. The orderly operation of cells results from the dynamic equilibria of a polyphasic colloidal system. But there are invariants persisting through different processes, and "purpose" seems to be implied in the tendencies to reaction which persist in an organism until the final end result is attained. The problem of the "unity of the organism" is that of understanding how these heterogeneous physiological processes are integrated.

In connection with this problem it is to be noted that the great merit of the theory of evolution is that it has forced us to regard the more complex organisms as having developed out of simpler forms of life. From the simplest organism up to the most complex there are physiological gradients and differences of potential which determine the direction and dimensions of the subsequent specialization of tissue and differentiation of function, so that the integrating mechanisms of higher organisms, chemical, mechanical, and neural, are possible because, to put it animistically, they represent nature's effort, through vast periods of time, to achieve complex but still unified organisms.

Once we have arrived at any species of organism on any given level in the evolutionary advance of life, we can study the activities of the organisms on that level in terms of the conversion of one form of energy into another. Indeed, an organism has been

defined by C. J. Herrick as a dynamic system of energies preserving its integrity through constant metabolism and the interchange of energies with its surrounding environment. The laws of energy transformation, sometimes called the laws of thermodynamics, apply to organic as well as to inorganic transactions. Thus the first law of energetics states that the energy expended by a physiological machine is equal to the energy-value of the food taken in, allowances being made for waste products. The validity of this law is not questioned on the physiological level, though its bearing on the supposed interaction of mind and body has been much debated. The application of the second law, which in one form states that energy tends to become degraded into heat, is questioned. Driesch, for example, suggests that the entelechy may suspend the operation of this law.

The energy changes resident in living matter are referred to as the metabolism of the organism. Metabolic processes have two aspects, anabolism and katabolism. Anabolism refers to the synthetic process of assimilation. Katabolism refers to the process of dissimilation whereby the complex compounds of high energy content are broken down. This process prevails in the animal cell. The stimulus may act as a trigger effect because it releases the stored-up energy that makes the organism an equilibrium under stress. Anabolic changes in organisms build up complex compounds out of simpler compounds possessing less energy, an illustration of this being the photosynthesis of chlorophyll in plants. Bergson refers to this as the canalization of energy, and argues in his book, *Creative Evolution*, that whenever energy, descending the incline indicated by Carnot's law, meets with a cause of inverse direction, which retards the descent, there life appears. Professor James Johnstone regards the capacity of converting one form of energy into another, without the loss entailed by passing through heat (or an increase of entropy) as a capacity peculiar to living beings. This contention is disputed by Sir W. M. Bayliss.[3]

The organic syntheses in cells are regulated by enzymes which influence the rate of metabolism. Enzymes are catalytic agents that usually increase, but sometimes decrease, the velocity of a reaction, without themselves entering into it. Thus the enzyme

[3] *Life and the Laws of Thermodynamics*, Oxford University Press, 1922, p. 9.

ptyalin is active in the conversion of starch into sugar Just as in physics the discovery of radium opened up vast, unexplored regions of intra-atomic energy, so vitamins, hormones, and enzymes reveal energy relationships not formerly suspected. But these revelations cannot be taken to support vitalism, for the chemical syntheses of organic compounds, as for example urea by Wöhler and the sugars by Emil Fischer, are now attained in the laboratory by artificial means.

From this brief survey we discover that although the behavior of living matter is not deducible from the laws of thermodynamics, it is no more inconsistent with these laws than molecular behavior is "inconsistent" with atomic or electronic behavior. The emergence of new properties is entirely consistent with a monism of action. However, the real justification for our rejection of biological dualism lies in the further application of the principles of physics and chemistry to the diverse processes of living matter.

One of the most notable of the unifications that bind physics to biochemistry is the application of the gas laws to substances in dilute solution. Ultimately the whole progress of biochemistry rests upon the kinetic molecular theory, perfected largely by Clausius, Maxwell, and Boltzmann. The molecular theory has enabled the chemist to investigate the behavior of colloids, which are so important in the life processes. The enzymes previously mentioned are themselves colloids. This kinetic theory is valuable, then, because the behavior of colloidal particles in suspension is not fundamentally different from the behavior of particles of molecular dimensions. The beginning here was made when Avogadro introduced order into the laws of Boyle and Gay-Lussac by making the assumption that, under the same conditions of pressure and temperature, the same volume of any given gas contains the same number of molecules. The fertility of this hypothesis is evidenced in the analogy that is drawn between gas pressure, due to molecular bombardments against the containing vessel, and the osmotic pressure of solutions. A further advance was made in the investigations of Willard Gibbs in thermodynamics, which have provided the theoretical basis for the study of different substances in heterogeneous solutions.

On the basis of these unifying generalizations, it can now be said that the behavior of solutions, osmotic pressure, equilibrium

constants, etc., have their basis in inorganic chemical and physical systems. The accelerating and decreasing of the reaction velocities of living systems is regulated by the same general laws of reaction velocities that obtain in inorganic chemistry. We need only mention Van't Hoff's statement of the influence of temperature upon the speed of reaction, a law which has direct applications in biological systems, especially when this principle, later restated by Arrhenius, is applied by Hudson Hoagland to the concept of "master reaction" (see Chapter XIX).

Along with the kinetic molecular theory must be ranked the theory of electrolytic dissociation of Arrhenius. A few illustrations of the relevance of this theory to physiological reactions must suffice. The interior and the exterior of protoplasm differ in their electrical charge, the surface of the cell being charged negatively. This may render less mysterious the process of cell division. That colloidal material should have the tendency to divide when it reaches a certain size may be due in part to alterations of surface tension as an electrical phenomenon Equally important are the electrical properties of surfaces in contact, or *interfaces*, and the effect of electrical charges upon the rate of passage of ions through membranes. And if we return to the earlier suggestion that there are baffling aspects to the bodily processes by means of which we resist disease, we find that the pathologist is not wholly at sea. In the neutralization of a toxin by an antitoxin we have the suggestive parallel of the neutralization of a moderately strong alkali with a weak base.

This physiological opposition of reaction tendencies between anions and cations may throw light upon the more mysterious process in neurology known as excitation and inhibition. Even psychology—in the form of gestalt theory—has found it possible to speculate in terms of biochemical reactions in the nervous system, involving the migration of ions in accordance with electrolytic laws. At this point, however, we are going beyond the scope of the present chapter, since it is not our purpose here to attempt the correlation of mental functions with their neuromuscular basis. We may therefore sum up the position set forth in the foregoing pages in what we shall term the empirical laws of biology. We term them "empirical" because the explanation of these laws must come after a statement of them.

IV. The Empirical Laws of Biology

(1) An organism is a definite organization of structures and organs. Physiological organs differ in function because of the differences in physico-chemical structure. All the processes of life have their analogues in chemical inheritance, mutation, and adaptation.[4] Life, therefore, is not a super-physical entity; it is a form of electrochemical behavior.

(2) The physiological basis of life consists of configurations of matter in which there is a balance of energies in delicate equilibrium. Material complexes, so far as their energy environments permit, tend to assume more and more complex forms in dynamic equilibrium.

(3) Each structural variation is accompanied by changes in the associated functional patterns.

(4) Protoplasmic systems of any given species tend to maintain their individual integrity through a variety of metabolic changes.

(5) The "action patterns" of protoplasmic systems form the starting point for the development of more complexly unified forms, each new form being attended by a correspondingly increased range of behavior.

(6) Since, as A. J. Lotka has pointed out, the fundamental object of contention in the life struggle in the evolution of the organic world is available energy, the advantage in the struggle for existence must go to those organisms whose energy-capturing devices are the most efficient. In addition to directing energy into channels advantageous to the organism, there will result an increase in the total mass of the system which serves as the seat of energy-flux.

(7) The work of Hering[5] and Semon[6] has developed the conception of memory as a general and fundamental function of living matter. Etchings on protoplasm by external stimuli leave reaction tendencies, called "engrams," as evidence of experience.

(8) The nervous system, as Charles M. Child has shown,[7] does

[4] Cf. *Chemical Phenomena in Life*, by Frederick Capek, 1911, Ch X.

[5] *On Memory and the Specific Energies of the Nervous System*, by Ewald Hering, Eng. trans., 1895.

[6] *Die Mneme*, by Richard Semon, Leipzig, 1904.

[7] *The Origin and Development of the Nervous System*, 1922.

not represent a new integration somehow superimposed upon protoplasm, but is rather a product of the primary integrating factors which make the organism an orderly whole. Specialization of tissue and differentiation of function follow the paths of action patterns permanently recorded in protoplasmic structure.

(9) As Professor Child has shown, a relation of dominance and subordination exists between the higher levels and lower levels of metabolic activity (rate).

(10) Memory is a complex synthesis of engrams. Mind, as a system of integrated energy-fields, dependent upon memory and neural tissue, constitutes the supreme synthesis of nature

It will be noted that in these laws the fundamental problem of whether structure determines function or whether function determines structure is not directly discussed. We shall return to this problem later, though in the meantime we will deal with this question in a brief manner in this next and concluding section of this chapter.

V. Chemical Regulation and Nervous Integration

In the eighth of our above-mentioned empirical laws we see that, according to Professor Child, nervous integration is not *sui generis*; it has its antecedents in chemical regulation and integration. Interestingly enough, as Child tells us, when we attempt to understand how the hierarchy of responses underlying physiological integration has been established, we find that we must also take into account the environment in which the organism functions. In other words, the origin of physiological individuality is to be found not in living protoplasm alone, but in the relation between the organism and the external world. Here is a brief summary of the argument.

According to the view of Professor Child, the primary effect of the stimulus on the undifferentiated protoplasm of a primitive organism is the increase of the metabolic rate at the point excited. But the stimulus does not stop at this point. It is transmitted as a dynamic change over the whole protoplasmic mass, perhaps by a wavelike irradiation, which undergoes a decrement of intensity in its course. The result of continued or repeated excitation "is the establishment of a gradient in protoplasm which constitutes a more or less permanent material substratum for the persistent

metabolic gradient independent of the local external stimulus."[8] These metabolic gradients or axes of polarity are the basis of organization and the factors in determining growth and differentiation. Professor Child does not tell us how the gradients that are established in individual organisms (or ontogenetically fixed) can hereditarily determine the organization of structure in the phylogenetic series. Granted that a relation of dominance and subordination exists between the levels of highest and the levels of lowest metabolic rates *in any given species*, why should organisms possess the particular structural differentiations (nervous and otherwise) which they now possess?

In order to solve this problem we should have to know more about evolution than we know at present. But we can see the direction from which the ultimate explanation must come. We know, for example, that regions of high excitability, by reason of their more intense metabolism, are dominant over regions of lower metabolism, and this doctrine that levels of higher energy activity dominate those of lesser metabolic rate calls to mind the parallel concept in physics of the difference in electrical potential. Thus it appears that life ultimately is an electrical phenomenon, so that we may expect that the evolution of living organisms must be controlled by electrical conditions, and this should prove highly satisfying to those who like to believe that at bottom nature is simple in her methods and procedure. Many scientists have warned us against simplicity, but there is no a priori basis for asserting that nature does not prefer simplicity.

As the reader may readily perceive, the idea that the nervous energy concerned in facilitation and inhibition (dominance and subordination) is fundamentally electrical in nature is quite in harmony with our idea that energy is the soul of matter, and that the human mind is simply the integrated energy-fields of the body. According to this view, matter consists of what we might term conventionalized energy patterns; an organism, as a system of "structures," is simply so much "bound" energy. If we regard this "material" substratum as the "structural" aspect, and the associated energy patterns as the "functional" aspect, we see that structure and function are interdependent, and that it is just as incorrect to say that structure determines function (materialism)

[8] Cf *Individuality in Organisms*, p. 34.

as it is to say that function determines structure (vitalism). A better statement is that nature produces organisms more and more complex, and that as she does this she must also see to it that there is a corresponding functional unity attending this structuralization. This functional unity or integration is the harmony of that body. This demand throughout the realm of the organic for unitary action, of which consciousness in human beings is a kind of reverberation, means that nature is constantly making minds, and that mind is always "in the making" in the sense that it is an ideal unity, never completely achieved, toward which bodily processes strive.

CHAPTER THIRTEEN

EVOLUTION, CONSCIOUSNESS, AND ELECTRICITY

In laying hands upon the sacred ark of absolute permanency, in treating the forms that have been regarded as types of fixity and perfection as originating and passing away, the "Origin of Species" introduced a mode of thinking that in the end was bound to transform the logic of knowledge, and hence the treatment of morals, politics, and religion.

—John Dewey

I. The Implications of Evolution

According to John Dewey, who is one of the most relentless advocates of evolutionary philosophy that the modern world has seen, the greatest dissolvent in contemporary thought of old questions, and the greatest precipitant of new methods of thinking and new problems, is the scientific revolution that found its climax in Darwin's book, *The Origin of Species.*[1] In Part I we have tried to take seriously the implications of the idea of mental evolution, and have accordingly sought to work out an evolutionary logic of human thinking. In Part II we are attempting to view the world from the vantage point of this new level of orientation, or mode of reasoning, which the evolutionary process will confer upon the human mind as it passes into the next stage in development. From this anticipated point of view we are now, in imagination, looking back upon the course of evolution and trying to give a coherent account of that advance as it might be explained from the newer level of understanding that is emerging in the very process whereby the mind reconstructs its picture of nature and its understanding of itself.

It is a Herculean task we have undertaken—a foolish and an impossible one some critics would say—the prosecution of which is made more difficult by the handicaps of language, the seeming obstacle of the "logocentric predicament," and the general

[1] Cf. *The Influence of Darwin on Philosophy*, 1910, Ch. I.

drag of established habits of thought. Nevertheless we must forge ahead as best we can, and now we continue our survey of evolutionary advance by trying to condense within the range of vision the tremendous sweep of biological development from ameba to man. Following that, we shall speculate upon the burden and the mystery of that panorama.

II. The Beginning of Organic Evolution

The present view faces the difficult problem of the "origin of life" only in the sense that the "conditions" for the synthesis of living matter here on earth must be determined. All we know of the matter is that in some way, perhaps through the influence of sunlight, the simpler organic colloids have been synthesized into the more complex protoplasmic systems which form the "physical basis of life." According to Pflüger, the fundamental difference between living and non-living colloidal aggregates lies in the fact that the living proteins contain a cyanogen group as part of their molecular composition. This conception is consistent with the idea that we may obtain some idea of how life might have taken its origin in the shallow sea from the work on the formation of formaldehyde and the sugars by the action of light of short-wave length (ultraviolet light) on carbon dioxide and water. The idea that the magnetic field of the earth may have assisted the light of the sun in building up optically active compounds, such as the proteins (which may possess a coiled or spiral structure), has already been discussed by the author.[2]

Once living matter was started on its evolutionary career, the characteristic phenomena of life—irritability, metabolism, growth, reproduction, etc.—became the permanent biological invariants of the behavior-complexes which eventuated in man, the present lord of creation. The irritability of living tissue, which is the beginning of the stimulus-response relation, is a property of unstable chemical compounds. In this sense gunpowder is "irritable," and for that reason we have no hesitancy in saying that the stimulus-response relation is present in the lowliest unicellular organisms, where specialization of tissue has not yet taken place.

The manner in which protozoa or unicellular organisms develop into metazoa, or multicellular organisms, is not fully understood,

[2] Cf. *Philosophy and the Concepts of Modern Science*, Ch. VIII.

although it is obvious from the principle of cell division—that the division spindle of the cells tends to divide at right angles to the longest mass of protoplasm—that the inequality of growth in the three possible dimensions of space will account for all the forms that organisms can take. Just why cells should divide and multiply is a matter still to be revealed, but in connection with the bioelectric theory of life it is interesting to note that, in H. Graham Cannon's theory,[3] the behavior of chromosomes in their orientation with respect to the centrosomes may be determined by fields of force active in controlling mitosis. This idea that the arrangement of chromosomes on an equatorial plane is analogous to the arrangement of floating magnets in Mayer's experiment was first put forth by R. S. Lillie in 1905.

It is generally known that the less specialized a cell is, the greater is its versatility in assuming different functions. The simple organic forms still preserve this plasticity of functional adaptation. In this connection it is interesting to observe that while sexual dimorphism took its origin in protozoa, a number of the lower organisms are potentially bisexual, and that it takes but a small change in the developmental factors—nutrition, for example—to make them male or female.

III. The Evolution of the Nervous System

In the lowest metazoa the co-ordination between the different cells of the colony is secured through chemical means. Thus the sponges have no nervous system, but they function somewhat as if they had. That is, there are muscle cells that play the dual role of receptors and effectors. The stimulus is transmitted slowly by what G. H. Parker terms "neuroid" conduction. In the sea anemone we find both nerve cells and muscle cells, which are the basis for reflex action.

The "nerve-net" type of organization, consisting of a continuous net of nervous tissue—which is found, for example, in the cœlenterates—is the most primitive type of neural co-ordinating mechanism. From the evolutionary point of view, the nerve-net system seems to have given way more and more to the synaptic system of nervous organization, which allows anatomical independence to the individual neurones. But the two systems are not exclusive of each other, for they may both exist together

[3] Cf. "On the Nature of Centrosomal Force," *Journal of Genetics*, Vol. 13, pp. 47–79.

within the same organism. The nerve-net still persists in vertebrates and controls the vegetative processes, such as are connected with the smooth musculature, where the autonomous character of the action is still preserved. Indeed, some investigators argue that the central synaptic system is still subordinate to the autonomic nervous system, and is concerned with securing the maximum gratification of the emotions, which seem to be largely dependent upon the smooth or unstriped muscle and glandular systems regulated by the older autonomic ("sympathetic") nervous system. With the development of the synaptic system, with its neurones functioning as relatively independent units, there is provided the basis for reflex actions involving a sensory, a motor, and a correlating neurone in the spinal cord. The ganglionic system that develops in the segmented worms increases in size at the anterior end to form the brain. The belief that consciousness appears with the development of the central nervous system, and arises at the juncture of the cortical neurones of the cerebrum, rests on the fact that the processes (as digestion) controlled by the autonomic nervous system of the vertebrates, which corresponds to the nerve-net of the lower organisms, are normally unconsciously performed.

Unlike the development of the nerve-net in the invertebrates, which comes from within, the evolution of the neuronic system of the vertebrates, or the cerebro-spinal system, is formed by an invagination of the ectoderm to form the neural tube. Three vesicles are formed at the anterior end of the central nervous system, with the ventricles thus produced filled with the cerebrospinal fluid; while the posterior end, the spinal cord, preserves a segmental character, with the spinal nerves issuing in pairs along the ventral column. The bending of the vesicles—the forebrain, the midbrain, and the hindbrain—gives a greater length in a smaller volume, and the anterior vesicle is thereby permitted to develop to such an extent that the cerebral hemispheres in time come to cover the rest of the brain enclosed within the cranial cavity. The cortex, the outer rind of the cerebral hemispheres, is the wall of cell bodies constituting the "gray matter" of the brain.

The foregoing survey may serve as a brief sketch of the development of the structural aspects of the central integrating mechanism of the higher vertebrates. The functional importance of the

nervous system will be considered after we have surveyed in an equally brief manner the evolution of receptors.

IV. The Evolution of Receptors

Organisms maintain their existence by adapting themselves to changes in the external world of things and events. They are the better provided for this adaptation in proportion to the number and variety of external phenomena to which they are capable of responding.[4] A perfect organism would have a solution to every problem, an adequate response to every stimulus; the entire universe would constitute its environment. In man alone do we find any approximation to this condition of universal adaptability.

All higher organisms are protected by some sort of shell or cuticle from excessive stimulation from without. Later on, individual parts of the surface are then differentiated in such a way as to be sensitive to only one group of excitations, while remaining insensible to all other forms and frequencies. The lower organisms are sensitive to chemical, thermal, and light changes, and their responses, known as "tropisms," are impelled by these forms of excitations. The stimuli that are of an injurious nature were probably responded to first of all. A current theory has it that in human beings these receptors for nocuous stimuli have survived in the free nerve endings in the skin, which give us pain sensations.

Since the most primitive organisms lived in the sea, they would naturally be exposed to a variety of chemical substances dissolved in water. It is found, for example, that the skin of fish is sensitive to acid, alkali, and salts; in many cases the hydrogen-ion concentration is the important factor. The senses of taste and smell are higher developments of this primitive chemical sense. Touch receptors were later developed into the present elaborate apparatus for cutaneous sensations.

In a general way, advance to higher levels of response is correlated with an increasing prominence of vision and hearing, with a diminution of importance of other modes of sensation. The eye and the ear are the principal "distance receptors," and the development of vision, which has been called "anticipative touch," has

[4] In this account of the evolution of sense organs I am indebted to the treatment of the subject in W. M. Bayliss' *The Principles of General Physiology*, C. S. Sherrington's *The Integrative Action of the Nervous System*, and C. J. Herrick's *An Introduction to Neurology*.

so accelerated the progress of evolution that man has been called a "space-eater."

In its origin the function of sensory apparatus was probably to serve as an adjunct to the motor system; but in the present highly elaborate sensory system, in which vision and audition are such important modes of experience, sensory stimulation has become an end in itself. Aesthetic experience, its own excuse for being, illustrates the general detachment of human activity from its original utilitarian, overt behavior-value.

As we have seen, the function of the receptive cells is to pick out from the mass of different movements in the environment constantly impinging upon the organism those to which the specific sense-organ is attuned. Each sense-organ is irritable to its own adequate stimulus. In this way the environment is split up so that only parts of it need to be reacted to at any one time. The whole process of the evolution of receptors consists in the development of sense organs for purposes of action, so that the objects of nature take on sharper outlines and distinctness. This is the position that Bergson defends in his *Creative Evolution*, where he argues that the geometrizing intellect has been developed for purposes of action upon objects in space. If we take the cerebrum, which has been evolved around distance reception, as the seat of "thinking," this idea gains plausibility. But the paradox which any such evolutionary theory encounters is this: Did the brain, which is the center of reference for perception and conception, thus in a measure "create" the external world, as we know it, or did the external world create the organism and its sensory apparatus? This, of course, raises the whole question of the "causes" of evolution. Lamarck, Driesch, and Bergson believe that we must assume that the evolution of structure cannot be explained without postulating some inherent, striving principle, which, through its adaptive efforts, causes the individual structural modifications, which are then preserved and passed on. Orthogeneticists also point out that these variations may persist, in spite of the fact that they have no apparent use at the time of their inception, and only later take on survival value after a number of such variations, persisting in a definite direction, have assisted each other, so to speak. One illustration of this is the gradual modification of the jawbones, so that one of the bones

drops out from the structures used in chewing and comes to be pushed up into the middle-ear cavity to function in the transmission of sound waves from the eardrum to the inner ear.

Another illustration, one developed at considerable length by Bergson, is found in the evolution of an organ of vision. Before going further it may be profitable to discuss this subject of vision as a special case of functional adaptation, inasmuch as it may throw light on the general nature of the human body, the superlatively intricate operations of which have always elicited the wonder of students of biology.

V. Vitalism and Evolution

One general postulate of all vitalistic theories is this: when it comes to explaining evolution, or stating the causes underlying the advance from simpler to more complex organisms, we must admit that there is some sort of super-physical striving entity in organisms that actually causes the individual structural modifications which produce new species. It is usually a part of this doctrine that these changes can be passed on to the offspring of these organisms. This last statement, that somatic or bodily changes leave a permanent record in the hereditary determiners in the germ plasm, is of course only another way of stating the doctrine of the inheritance of acquired characteristics.

Perhaps the best statement of this view has been given by Bergson in his classic, *Creative Evolution*. As an illustration of how the vital impetus, ramifying along divergent lines of evolution, may manufacture like apparatus from unlike means, and thus transcend the mechanistic principle that like effects must have like causes, Bergson cites the case of the development of the eye of the Pecten, a mollusk, and the vertebrate eye. Here we have homologous structures developed in two species which had separated from the parent stem before the appearance of an organ of vision. The problem this presents to the mechanist is that of explaining how accidental causes (random variations) occurring in an accidental order can on several occasions have come to the same result, the causes being infinitely numerous and the effects infinitely complex.

The eye is complex, being constructed of a number of parts so functionally interrelated that it seems to have been designed for the purpose of vision. How can this correlation of function be explained? The theory of selection from chance variations in all

directions (Darwin's theory) does not explain how the parts of the visual apparatus, through all these trial-and-error experiments, could remain so co-ordinated that the eye could continue to function effectively. That a change in the germ plasm influences the formation of the retina, cornea, iris, and lens at the same time is conceivable; but that all these simultaneous changes should occur in a way to improve or even maintain vision is not admissible. A more dramatic statement of the improbability of nature's arriving at such a complex organ as the vertebrate eye through "accident" or "chance" combinations was presented by J. J. Murphy, when he affirmed:[5] "It is probably no exaggeration to suppose that in order to improve such an organ as the eye at all, it must be improved in ten different ways at once, and the improbability of any complex organ being produced and brought to perfection in any such way is an improbability of the same kind and degree as that of producing a poem or a mathematical demonstration by throwing letters at random on a table."

Another way of accounting for the appearance of the eye is to suppose that variations are due, not to accidental inner causes, but to the direct influence of outer circumstances. Though the mollusks and vertebrates have evolved separately, they have both remained exposed to the influence of light. It might be argued, therefore, that the resemblance of the two effects may be explained by the identity of causes: light acting directly upon unorganized matter so as to change its structure, and somehow adapt this structure to its form. But Bergson argues that the term adaptation is here ambiguous. In one sense it means the receiving of an impress from the outside; in another sense it is a positive reaction, a solving of a problem. It is in this sense of the word that we say that the eye has become better adapted to the influence of light. Nature herself appears to invite a confusion of the two kinds of adaptation, for she usually begins by passive adaptation and later on builds up a mechanism for active response. Life adapts itself to matter at the outset, and later directs the movement it adopted. When we say that the eye makes use of light, we do not merely mean that the eye is capable of seeing; we mean the precise relation that exists between this organ and the apparatus of locomotion. The retina of the vertebrates is prolonged into the optic nerve,

[5] Quoted from Sir Arthur Keith's Huxley Lecture on "The Adaptational Machinery Concerned in the Evolution of Man's Body," *Nature*, 1923, Vol. 112, pp. 257–268.

which is continued by cerebral centers connected with motor mechanisms. No one would hold that light has physically caused the formation of the nervous system, or the muscular system, all of which is implicated in the usefulness of an eye. According to Bergson, whether we will or no, we must appeal to some inner directing principle in order to account for the convergence of effects.

I have entered into this lengthy exposition of Bergson's theory because the illustration he selects is one of the most difficult to deal with in non-vitalistic terms, and because we now have information at our disposal (which Bergson knew nothing of at the time he wrote his book) that throws light upon the problem of correlating functions in organisms. We now turn to this evidence concerning chemical regulation and control, which we have reason to believe may explain those interrelations of structure Bergson refers to.

More recent work on the mechanism of correlation and functional interdependence may help the biologist to understand many of the phenomena that hitherto have seemed so baffling. The recent discoveries in connection with the eye are especially interesting. In the case of vision the researches of Dr. Warren H. Lewis have shown how the optic cup, which ultimately forms the retina of the eye, grows from the wall of the brain toward the embryonic skin or ectoderm. Quoting from Sir Arthur Keith's statement: "When the cup comes into contact with the ectoderm the underlying cells begin to proliferate and arrange themselves so as to form a crystalline lens. Dr. Lewis transplanted the outgrowing optic cups of tadpoles, and found that if they were placed under the ectoderm of the neck or belly, the result was the same; an optic cup caused the underlying cutaneous cells to alter their nature and form a lens. Dr. Lewis realized the significance of this discovery; in the developing embryo, although only of certain species, one group of cells can enslave and control the behavior of another group. He gave us a glimpse of the kind of evolutionary machinery employed in fashioning a highly purposive structure such as an eye."[6]

These results on the regulatory influence of one group of cells on another take on added significance in connection with the

[6] *Loc. cit.*

phenomena of chemical substances and ferments (hormones or autocoids, etc.) passing from one structure to another to influence the behavior of the latter. The theory that hormones may influence heredity has already been advanced by J. S. Cunningham. Whatever may be the value of suggestions concerning hormones as "formative stimuli" and as the bearers of racial memories, such illustrations of chemical integration and regulation are of value in warning us against the hasty conclusion that no natural causes are conceivable that can enable us to understand the phenomena of functional dependence and organic intra-adaptation.

In connection with this problem of the role of biochemical regulation in genetics, the experiments[7] of M. F. Guyer and E. A. Smith must be referred to as particularly noteworthy. These investigators injected into pregnant rabbits serum from the blood of fowl, into which extract from the lens tissue of rabbits and mice was introduced, with the result that the lenses of the embryonic rabbits were attacked and the young showed defects of the eyes. These defects persisted in the second generation of rabbits, into which no injection was made. Such results seem to suggest that modifications of the individual constitution may produce a racial result. They also lend support to the notion of chemical regulation, and therefore indirectly reinforce the notion that hormones may exert a chemical regulation having a hereditary effect.

And do these new discoveries, which promise a solution to the problems that the vitalists hold can only be solved by the introduction into organisms of non-physical forces, finally discredit the teleological viewpoint? The answer, it seems to me, turns on whether vitalism is necessary to the admission of the reality of purposive response in organisms. My reply has already been given. The force of the previous argument has been lost if it has not been established that we can admit the reality of purposive striving and adaptation without introducing mysterious forces into organisms. But the teleology we advocate is natural, inherent within nature. The notion that things happen by "chance" (that is, from the random combination of "independent" events according to the laws of probability) is now pretty well discredited in any organic science. Even in chemistry the mutual "affinities" of substances for each other often serve to make

[7] *Journal of Experimental Zoology*, 1921, Vol. 31, p. 171.

"chance" calculations irrelevant. Nature's dice are sometimes "loaded." The probability of life on earth is not a matter of chance, because mother earth does not toss oxygen, hydrogen, and other elements around in the way in which some of her human offspring toss dice. In our own theory the explanation of the emergence of a new order out of the antecedent conditions lies in the fact that the future, which is not yet, somehow influences the present, which is. *How the possibility of what a thing might become actually helps to determine what it does become is the ultimate mystery of evolution.*

We have argued that the phenomenon of temporal transcendence arises out of the relation of the whole universe, as a unitary continuum, to its parts. The basis for this conception of the cosmos as an unbounded but self-contained unity-in-variety, which determines what the present configuration of events will be in terms of future possibilities, has already been laid in the conception of the physical field as the character of nature that expresses this relatedness between the past and the future. On this theory, structures make their appearance before the performance of functions to which they later appear to be adapted, and we see only the visible sector of a curve of action, or a field of possibilities, the remainder of which is invisible The way in which this notion of a physical field reappears on the human level in the cognate concept of a mental field we shall see later (Chapter XX).

VI. Cerebral Behavior

Having thus surveyed the evolution of receptors and the central nervous system as the correlating mechanism that connects sensory and motor points of the body, and thus through its co-ordinating activities secures harmony of action of complicated receptor-effector patterns, we are now in a position to attempt to fit cerebral and mental activity into the general scheme of a monism of action. The supreme importance of the nervous system in behavior is obvious to all students of biology. It provides for variability of response, for harmony of action in adjustments which involve extremely complicated sensori-motor configurations, and is the basis of "intelligence," which may roughly be defined as the ability to learn by experience. Intelligence is the capacity of bringing relevant past experience to bear in adjustment to the novel situations that constitute the problems of the organisms.

Biologically, this seems to be largely a problem of complexity of neural tissue.

That intelligence is not peculiar to man, but has its beginnings early in the ladder of evolution, is evident from experiments on lower organisms, as H. S. Jennings has shown. Intelligence has its forerunner in the "trial and error" learning, or experimental behavior, which is found in the Infusoria. Thus the Slipper Animalcule overcomes its obstacles by reversing the action of its cilia, backing away from the obnoxious stimulus, and advancing again on an angle slightly diverging from the original axis; and Stentor solves its problems by selecting the appropriate response from its behavior-repertoire.

Higher organisms come into the world with an inherited set of responses, and it takes only the appropriate stimulus to release the adaptive adjustment. There has been and is much dispute concerning the definition of these supposedly inherited modes of response. "Instincts" have been defined in various ways, but none of these definitions has proved generally acceptable. The consequence is that some students have gone so far as to deny the existence of specific instincts.

There is also the question of how instincts have been built up, the problem again arising which has refused to be put out of court: whether instinct is "lapsed intelligence" in the sense that it represents the persistence of a form of response one purposively and consciously performed, or whether the evolution of behavior is the evolution of structures, determined by principles in which the inheritance of acquired characteristics plays no part. This problem of the relation of intelligence to instinct has been a fertile field for controversy for many years. On the anatomical side, we find the main dichotomy to lie in the difference in size of the cerebrum: instinctive behavior reaches its highest development in ants, bees, and wasps, whose "little-brained" nervous systems stand in marked contrast with the "big-brained" mammals, with their consequent intelligent behavior. It is for this reason that we may designate *mind* as a form of cerebral behavior. However, the integrity of this supposedly clearly defined difference between instinct and intelligence is threatened by the development of the doctrine of the "conditioned reflex," the purport of which is the reduction of all learning to the status of acquired responses, which are conditioned into reflex behavior in such a manner that the

factor of "intelligence" becomes a name for neurone and synaptic factors such as "modifiability," "retentiveness," etc.

From the point of view of a monism of action, what needs to be pointed out here is the reason why people do the things that they do. If we accept what many students of heredity take to be a fact, that there are innate traits in human beings which are inherited, we must then start from the position that in some way or other there are potential pathways of response already laid down in the nervous system, even in the child who, in his early infancy, has not modified to any extent these inherited tendencies to reaction by alteration of the resistance gradients of cortical patterns (if inherited abilities are there localized) by training or experience. All subsequently acquired reactions modify these pathways, but what we can learn is, in turn, determined by the original inheritance. What we are, then, is the non-additive sum of our inheritance and the modifications due to experience. The doctrine that the mind, as a non-biological entity, acts as a kind of switchman, standing at the cortical synapses, shunting trains of nervous energy over this or that track, meets with grave difficulties.

There is another theory that is of value in connection with the above picture of the human learning organism. This is the theory that cerebral nervous impulses tend to irradiate over a number of pathways, and that it is only through repeated behavior that a definite response is linked more or less automatically with a definite stimulus by the formation of a "final common path." The hypothesis of irradiation is interesting because it suggests the mechanism whereby the "collateral ideas" that normally serve as a check upon behavior are inhibited by "suggestion." This suggestion throws some light upon the matter of belief. Both belief and readiness to act depend upon the resistance, or lack of it, that an idea meets with in the individual. This past experience may be stored as brain patterns, and under normal conditions any idea tends to call up the relevant ideas associated with it. Suggestion, hypnosis, fatigue, narcosis, and toxic conditions are circumstances in which these collateral ideas are temporarily banished from consciousness, and can no longer serve as checks to inhibit behavior that normally would be regarded as wrong or ridiculous by this "same" individual. Such conditions eliminate these inhibitory ideas by draining the nervous flux, which ordinarily tends to irradiate and arouse the collateral patterns, into one channel which is thereby strengthened.

Although the physiologists do not fully understand "facilitation," "inhibition," and the "drainage" of nervous energy, all of which are involved in the psychological phenomenon of attention and concentration, and no one can say what happens at the synapse, there is no reason for supposing that when the explanation is forthcoming it will be given in terms other than those that have always been connected with progress in science. The advantage of the preceding view seems to be that it provides a basis for the understanding of individuality and of "multiple personalities" as complexes of patterns of ideas and feelings, which may split up into separately functioning subordinate patterns, if the integrative action of the nervous system is not sufficient to unify these clusters of sub-individuals into a unified personality.

In the foregoing account I have emphasized the neural conditions of human behavior. This emphasis upon the nervous system as an autonomous organ of central integration will be regarded by the Behaviorists, who stress the response (effector) side of behavior, as old-fashioned. And yet the idea that the brain is the seat of spontaneous phenomena finds support in the recent studies of "brain waves" (electroencephalograms) and other centrally initiated phenomena. The present position is in accord with the statement of G. E. Smith[8] that "the secret of man's distinctive attribute (intelligence) is hidden in the texture of his brain, and perhaps will never fully be revealed." To me it seems impossible to stress too much the significance of the nervous system, because in the facts of synaptical resistance is to be found the explanation of the gradation of energy-thresholds, or levels of synthesis, which can account for neurasthenia, senile degeneration, regressions, and other abnormal aspects of personality, consisting in the dropping down to levels of response requiring less energy expenditure. And it is through some such conception of the evolution of behavior as the progressive synthesis of levels of reaction that the integration of mind is to be viewed.

VII. Physiological Integration

The tenability of the view herein set forth—namely, that the unity of mind is what might be called an overtone or harmony of organismic integration—rests upon the validity of the thesis that there is no opposition between physiological processes and the conduct of mind, even as it is conceived in intellectualistic terms.

[8] "The Human Brain," *Nature*, Vol. 113, 1924, p. 390.

To this end may we point out that bodily processes bear the stamp of their subordination to the synthetic character of organic integration of function in the "organism as a whole." If this is true, then the prime fact of consciousness, the purposive character of its movements of abstraction and generalization, is a reverberation of physiological integration through the differentiation of structure and integration of function.

This principle of a hierarchy of levels of synthesis, introducing unity of action through the relation of dominance and subordination between the integrating mechanisms of complex organisms, is being recognized on all sides. That it represents the actual pathway of evolution is pointed out by J. A. Thompson, who holds[9] that the clue to the maze of animal behavior "is that there has been at level after level a process of automatization or organization, which makes for economy of time and energy, and also, if it does not go too far, leaves the organism free for experiment and initiative." And to this we would like to add that this concept of evolution and behavior gives us the key to the problem of how the evolution of the brain as the correlating mechanism through which the unification of tactile and kinaesthetic senses with stereoscopic vision, involving the eye movements of accommodation and convergence, has been secured; and how the creative synthesis of visual space and motor space as given in the handling reactions has provided the basis for the development of curiosity in man for knowledge concerning the world about him. In a very real sense philosophic vision is a sublimation of distance-receptor behavior.

VIII. Psychic Synthesis

In the preceding discussion we have found that the difficulty of understanding the life processes arises out of the inability to describe how, in the varied and complex interactions within protoplasmic system, the unity of the organisms as a whole is maintained. It is the old problem of integration in a new form. The most adequate theory of this fact of the unity of the organism is presented in the principle of a hierarchy of levels of synthesis, introducing unity of action through the relation of dominance and subordination between the integrating mechanisms that arose in an evolutionary sequence. The facts of biological integration

[9] Cf. *The System of Animate Nature*, Vol. I, 1920, p. 194.

were beautifully summed up by F. W. Gamble in the statement, "The infinitely varied animal fabric appears to be the exquisitely balanced individual expression of processes that quicken and restrain." How shall we visualize these mutually interlocking drivers and restrainers within protoplasmic systems? Is there, in addition to chemical and neural integration, an integration through fields of force? Can the analogy of the physical relation between energy fields and the discrete entities of material aggregates be of any service in explaining functional unity and psychic synthesis?

Our answer of course—here and elsewhere—has been in the affirmative. We seriously propose that the relation between matter and the field is the true homologue of the relation between the individual structures in organisms and the unified responses and experiences that have puzzled all students. We postulate that every atomic fact of nature, from an electron to the "all or none" pulse which is the quantum of nervous energy, is but a visible sector of an invisible environing field of force (or action, as energy integrated through time), which determines what kind of configuration can be further assimilated to this stress center. The growth of organisms is guided by the developmental possibilities latent within the biological fields from which the morphological forces must select their patterns to integrate into the original complex. This conception of interlacing fields of force as the basis of the pathways constituting the "growth potentials," "physiological gradients," etc., for the specialization of tissue promises an explanation of the structural-functional evolution of organic forms, just as it does in the domain of the inorganic.

The essentially electrochemical character of biological phenomena is evident in (1) theories that ascribe the physico-chemical state of protoplasmic colloids to the hydrogen-ion concentration of the medium; (2) speculations concerning the effect of the electric charge upon the rate of passage of ions through membranes; (3) the dependence of change of state of nerve and muscle upon the changes in the ionic concentrations of the cells (suggested earlier by J. Loeb and Nernst, and more recently by R. S. Lillie and P. Lazareff); and (4) the Nernst-Lillie theory of nerve conduction, which pictures it as the propagation of a series of action currents considered as pulses of depressed polarization and increased permeability, traveling along the membrane surrounding the

conduction pathway. Although electrical theories of life, accounting for these and many other phenomena of the living organism in bioelectrical terms, have attracted not a few theorists, only one investigator, Dr. George W. Crile, has systematically worked out the details of such a conception. Our own theory can accept most of what Dr. Crile has set forth, but in our picture we have included the notion of biological relativity (biochemical and bioelectric) as an absolutely essential feature. In this next section we set forth the reasons for the adoption of this view.

IX. Physical Relativity and Psychical Relativity[10]

Up to the present time it has been assumed that Einstein's theory of relativity is applicable only to physical phenomena. Relativity principles have not been admitted to have any significance for biological or psychological phenomena. To be sure, W. Köhler and other "gestalters" have had much to say about the relativity of "sensations" and conscious experiences generally. These investigators have also speculated concerning the relative properties of the physiological systems that presumably underlie phenomenal patterns. Except for the speculations of George Humphrey, previously cited, this relativity of properties has not been regarded as in any sense an expression of Einsteinian relativity.

The view of the "orthodox gestalters," however, presents but one interpretation. Another possible conception is found in the attempt to assimilate psychological relativity to more general physical principles. We then ascribe the inability of the gestalters" to arrive at a synthesis of physical and psychological phenomena to the particular type of biochemical theory they have embraced. If we search for other physiological analogies that might conceivably provide the substratum for conscious processes, it appears that one might exhibit psychological relativity as the subjective counterpart of Einsteinian relativity of brain processes. To illustrate and support this view, let us compare the type of explanation employed by Professor Köhler with another type of explanation that promises such a synthesis as we have suggested.

Consider the phenomenon of simultaneous color contrast. Here

[10] This last section is taken from the author's paper, by the same title, which appeared in the *Psychological Review*, 1930, Vol. 37, pp. 257–263. The diagram is taken from an article in *Psyche*, "Contributions of the New Physics to Philosophy and Psychology," 1930, Vol. 11, pp. 65–87.

the chromatic properties of the perceived pattern are not "absolute," but "relative" to the total situation. For instance, a gray square set within a green background no longer appears gray, as it did before it was thus situated. Again, when a green and a red surface are set side by side, the color of each along the boundary line appears to be intensified. Now, according to Köhler, in optical processes the perceived contours are preserved by "forces of contact" that depend upon the difference in the properties of the sides of the contours in the brain. Köhler is therefore forced to seek for the physiological conditions of the relative character of the perceived color qualities in the relative differences in the properties of the chemical reactions in the underlying brain fields. He points out in his book, *Gestalt Psychology*,[11] that in dealing with solutions of different ionic concentrations the answer to the question of whether a given solution is "electropositive" or "electronegative" depends on the relation of this given solution to the other solution with which it is being compared. Here we find that the "gestalt" property of an electrochemical whole has the same features as the brighter and darker side of a sensory pair of gray stimuli.

Professor Köhler does not identify the relativity of color qualities with the relativity of the ionic concentrations of solutions. He does, however, point out that the differences in chroma are usually associated with differences in brightness, which act as effective forces of separation. So far as I am aware, this is as close as Köhler has come to stating the physiological condition of color perception.

Now let us consider the other type of explanation of this kind of phenomenon, which rests upon a different sort of physical analogy and comes closer to a true physical relativity.

The phenomenon of the Doppler effect is well known to physicists. It appears in sound as well as in light transmission. We are all of us familiar with this phenomenon in the experience of hearing the pitch of a bell at a railroad crossing change as the train we are in approaches, overtakes, and passes the ringing bell. When a train is approaching the crossing (or an automobile sounding its horn is approaching our own car), the source of the sound is moving *relatively* toward us. Accordingly, we overtake a greater number of sound waves per unit interval of time, and hence

[11] 1929, p. 218.

the pitch appears higher; as we recede from the source of stimulus, fewer waves strike our ears per unit interval of time, and the pitch of the sound appears to be lower. The quality of the sound (stimulus) depends upon the relative motion of the perceiver with respect to the source of stimulation. In other words, *a variation in the relative velocities of the observer and the thing observed produces the same effect as an objective variation of the stimulus when the observer is at rest with respect to the source of the stimulus.* Now, we ask, is there anything in the brain processes that could correspond to the relative acceleration and deceleration in the foregoing case?

In surveying the possibilities, we come across the interesting theory of nerve conduction, which supposes that each nerve cell has its characteristic frequency, and that nerve conduction is the process whereby a stimulus is passed from one cell to another with which it is in "tune" (or isochronous). Now let us see how this theory of L. Lapicque might be related to physical relativity.

At the outset we must note that the way in which a present stimulus is perceived is a function of the previous history of the organism. Furthermore, the manner in which a thing is perceived is also related to the other activities going on in the brain at the same time. In terms of the chronaxic theory of nerve activity, this may mean that the activities of any given set of neurones are related to the activities of other neurones; perhaps something analogous to the acoustic phenomenon of "forced vibration" may be operative here. Under such conditions the same objective stimulus will not arouse the same response; its qualitative variables will not be reproduced in consciousness in the same way. The brain would interpret the old physical stimulus as a new conscious quality. Whether, in the case of vision or audition, this new quality would appear to be of a higher or a lower frequency would depend on whether the rhythm of discharge of the cell (or cell group) had been raised or lowered relative to its former frequency and to the frequency of adjacent neural units. Perhaps this type of relativity is illustrated in the realm of taste experience, where, as everyone knows, the eating of an apple *after* you have eaten candy makes the "sweetness" of that apple appear quite different from what it would have been if eaten *before* the candy.

Because of the prevailing ignorance of brain processes, it is difficult to work out the details of this conception. But a possible application and test of this view might be found in the alleged

production of visible radiation from excited nerve fibers. From the fact that when you view a band of red light in a dark room you see the band surrounded at the ends with reddish-blue arcs, Dr. Christine Ladd-Franklin argued[12] that we are actually seeing the light emitted by the nerve elements active in responding to the red band But Dr. Ladd-Franklin has not been able to offer any explanation of the color of this secondary experience, which involves higher frequencies of light than that of the original experience (from red to reddish-blue). If this is a case of fluorescence, as Dr. Ladd-Franklin suggests, it violates Stokes' law, which states that the emitted light is of *lower* frequency than the absorbed light that produces the radiation. If this law applies here, the red band ought to be surrounded by infrared light, which, unfortunately for Mrs. Ladd-Franklin's theory, would be invisible (heat rays). But if we introduce relativity considerations it might appear that the light emitted by active nerve fiber would appear to be of one color when seen subjectively (in consciousness), though when studied objectively it might be of quite a different quality—in the visible region, infrared, or even ultraviolet. No matter what it is, if the frequency of the light we see when we see our own nerve currents is different from that as revealed by objective study of the radiations from active nerves, this would be confirmation of the theory here urged.

The working out of such a scheme is a difficult problem, both experimentally and theoretically. But other complications arise when we consider the fact that in physics shifts in the spectrum lines occur under other conditions. In astronomical observations, displacements of the Fraunhofer lines toward the red or the violet end of the visible spectrum occur under the following conditions: (1) When a star is receding or approaching the observer the shift is, respectively, toward the longer or shorter wave length. This is the Doppler effect, previously discussed. But (2) there will also be a displacement of the lines toward the red end of the spectrum when an atom (in the sun, for example) is in a gravitational field, which slows down the atomic vibrations. This phenomenon constitutes one of the experimental verifications of the theory of relativity.

We have already suggested the phenomenon in the brain that

[12] See her paper on "Seeing Your Own Nerve Currents," in her book *Colour and Colour Theories*, 1929, pp. 215–219.

might be analogous to the first type of physical relativity. If we could discover any biological correlate of the second type of relativity effect, this would make the correspondence between physical and psychical relativity much closer. At present there is little theoretical justification for believing that this second type of phenomenon might also be illustrated in brain processes.[13]

Now let us examine another parallel between physical and psychical relativity.

As we have pointed out in our list of "contradictions" in modern science (Chapter III), the same body can both give and not give a magnetic field. The basis for this fact is presented by A. S. Eddington[14] in the statement that an electrically charged body at rest on the earth possesses an electric field but no magnetic field. A moving change constitutes an electric current which, in accordance with the laws of electromagnetism, gives rise to a magnetic field. There is no magnetic field for a charged body at rest on the earth, but when the earth is in motion with respect to an extramundane body, a physicist on such a body would detect a magnetic field even though the instruments on the earth would not show a magnetic field.

In order that such considerations could be applicable to brain processes, it would be necessary to demonstrate the existence of electrical fields in cerebral processes. Now it is known that differences of electrical potential do exist. It is also inferred by some, P. Lazareff for example, that since we have electromotive forces present in the brain, electromagnetic fields must also accompany brain processes. Some would be reluctant to ascribe much importance to such fields of force, since they cannot be very strong, but we must not overlook the possibility that such fields might be strong enough to initiate processes that could then proceed on their own free (potential) energy. And here is where relativity enters. Köhler has suggested that the attraction of two similar mental processes for each other is analogous to the attraction of two parallel wires having electrical currents flowing through them. According to the present hypothesis, if two brain processes occurred of sufficient rapidity with respect to inter-

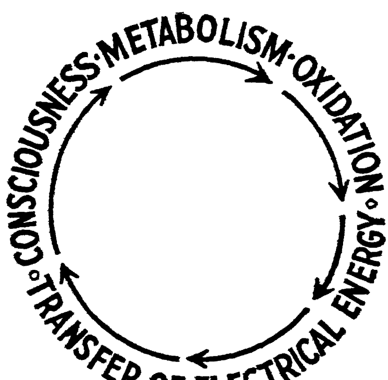
[13] We have suggested, however, that our time-sense is a function of the velocity constants of the chemical reactions in the brain, and these are related to the earth's gravitational constant!

[14] Cf. *The Nature of the Physical World*, p. 22.

mediate processes in the brain, a relative field of force might be set up in each such process (or between them), and this might underlie the "attraction" of two such similar processes for each other. On the experimental side, the actual relativity of bio-electric potentials has already been referred to, though more is said on the matter in the next chapter.

Gestalt psychologists have pointed out that parts of the brain which are structurally disparate may be dynamically unified into functional wholes. And if we are going to substitute dynamic explanations for structural explanations, may we not just as well ground the relativity of conscious processes in the physical relativity of electromagnetic fields of force? Since the brain itself is a physical system in which relative movements occur, is it not reasonable to suppose that psychical relativity may be assimilated to more general physical principles?

This view that energy-fields in the ether, or patterns of lines of force which *are* the ether, constitute the non-material substratum which is the "soul" of "matter" seems to be entirely consistent with the idea that radiation plays some fundamental role in the fabrication of consciousness in the body. In our own scheme we have proposed that the dynamic relation between consciousness and radiation may be represented as follows:



It must be kept in mind that when we speak of the "ether" we are not subscribing to the old-fashioned ether of space. In our view the "ether" is only a name for the fact that the behavior of relatively discrete particles is ordered in time, so that the ether is but another way of describing the fact of dynamic interaction.

Moreover, this more general use of the term takes us outside the conventional space-time picture of even a four-dimensional manifold. We insist that there is no way of representing in three-dimensional space the properties of psychic life Consciousness emerges as a new dimension. Just as the wave that we see moving over the water is composed of molecules which move in but one direction (up and down) while yet the crest of the wave moves forward in a new direction (horizontally), so consciousness may be regarded as such a phenomenon of a higher dimension, in the sense that it emerges out of a synthesis of brain patterns (neuronic frequencies) and represents the constellation of lines of force accompanying cortical patterns.

The "psychic ether" we have postulated, we repeat, is not the ether (guiding wave) of the electron. In an electromagnetic field the electric and magnetic vectors are at right angles to each other. In a similar way the ethereal components of the brain processes are perpendicular to the lower (material) manifolds. In this sense the present view is not "materialistic." If the materialistic fallacy consists in identifying a reality with its behavioristically observed conditions, then the present view is not guilty of that fallacy. It is admitted that the objectively observable conditions of a conscious process are electrochemical changes in the cortex (recorded as electroencephalograms), but it is also held that in connection with cerebral chemistry phenomena appear subjectively which are not recorded in textbooks in chemistry. While mind is held to be a physical reality, psychic phenomena *as experienced* lie outside the boundaries of experimental verification, at least through the use of present types of instruments.

CHAPTER FOURTEEN

THE MENTAL EVOLUTION OF MANKIND

Those who have tried both methods of teaching logic usually find that most students who make an attempt at understanding traditional logic are successful, while those students on whom mathematical logic is imposed make little headway in understanding or in using it. One possible explanation of this may be found if we accept the organismic analogy. In what is known as the culture-epoch theory we have a psychological doctrine of mental evolution which is similar to the biological doctrine of embryological recapitulation. According to this theory, the human mind, as it evolves in the individual, retraces the intellectual evolution of the race. If there is a valid analogy between the two processes of recapitulation (bodily and psychic), it may be that human beings find it so difficult to think in terms of any other doctrine besides traditional logic because in thinking in accordance with the logic of Aristotle, Bacon, and J. S. Mill we are merely reasoning along the lines towards which we are naturally predisposed by our mental heredity.

—O. L. R.

I. Types of Human Orientation

In Part I we have outlined a theory of the mental-social evolution of mankind. We have argued that primitive man functions on the level of pre-Aristotelian orientation, that the human mind today is functioning on the second level of Aristotelian logic with its classical laws of thought, and that in the future the human mind will attain the coming third level, the non-Aristotelian mode of understanding, which will represent a new insight into the unity of nature. When this level is achieved, the present laws of thought will appear as special cases of a broader mode of reasoning. As with primitive man, our semantic reactions will again be non-Aristotelian, but for different reasons: not because we completely disregard any principle of identity, but because we see an underlying unity in which "individuality" becomes rela-

tive to the whole of which it is a part. Thus we overcome the ancient fallacy of the absolute individuality of substance.

This new mode of understanding, with its organismic logic, will appear as a mutation which will gradually spread through the human race. The great mass of people will require some time before they catch up with the advancing frontier, and by then the vanguard will have moved into new territory. As a matter of fact, a considerable part of the human race today finds difficulty in applying Aristotelian logic in their thinking, partly because they are still carrying along some of the mental equipment of primitive man. This is especially true of children, whose imaginative personifications seem to recapitulate primitive man's inability to distinguish between the "self" and the "not-self"—a mode of response which disregards the law that *A is A*. We also see this fact illustrated in the phenomenon of eidetic imagery. As the writer has pointed out,[1] the fact that eidetic images are commonest among children and primitive peoples leads to the conclusion that the presence of this phenomenon in moderns is indicative of a psychological atavism, giving us a clue to the evolutionary synthesis of human personality. Many adults, however, outgrow the earlier stages of mental and social evolution and catch up with thinking at its best as illustrated by the accepted models of perfection of their own period of culture. One explanation of these facts is given by the writer in the quotation which heads this chapter.[2]

As the discerning reader will observe, the present view leans heavily upon the concepts of psychoanalysis. Formal logicians and intellectualists have little use for this approach to an understanding of the human mind, but in the author's opinion Freud and his co-workers have thrown much light upon the make-up of human nature. In the present chapter we propose to make an investigation into this subject as it relates to our own theories. We need to see how the notions of psychic regression and atavism (individual) and mental recapitulation (social) fit into the scheme of a universal behaviorism, or monism of action.

II. Psychic Regression and Biology

Of the various concepts employed by psychoanalysis, the concept of regression is one of the most useful. A psychic regression

[1] Cf. *Philosophy and the Concepts of Modern Science*, p. 209.

[2] From *Humanistic Logic*, 1930, p. 105.

may be defined as a return to an earlier state of behavior, accompanied by the disappearance of later-acquired forms of behavior. In the course of such psychic atavism there appear forms of conduct which have hitherto been inhibited by the individual, these forms representing the responses characteristic of the level of response dominated to a large extent by instinct.

In some cases it is clear that this loss of the more recently acquired and less firmly established responses is correlated with a very definite degeneration of nervous tissue. Hughlings Jackson[3] regarded progressive mental dissolution as being due to the loss of control of the superior centers over inferior nervous centers. He argued that the mental symptoms (illusions, hallucinations, extravagant conduct, etc.) associated with the dissolution of nervous tissue are manifestations of the activities of structures of lower (more primitive) levels of evolution.

More recently, and in another field, it has been established that in visual perception, response to brightness represents the most primitive level, to pattern or form the second level, and to color the most recently acquired function. Dr. K. S. Lashley states that pattern perception (he might also have added color) is localized in the cortex, and discrimination of brightness may be wholly a function of the thalamus and midbrain. In case of progressive degeneration, these functions disappear in the reverse order of development. In this connection it is interesting to recall that, within the field of color response, Dr. Ladd-Franklin regarded partial and total color-blindness as different stages of atavistic visual perception.

Another illustration of phylogenetic levels of synthesis is as follows. On the basis of experiments on the regeneration of nerves, Sir Henry Head and his colleagues have distinguished two kinds of mechanisms on the afferent side of the nervous system. These are: (1) the *protopathic* stage, characterized by the absence of any exactness of discrimination or localization, and by the presence of pronounced feeling tone; and (2) the *epicritic* stage, which marks the return to normal spatial perception of exact discrimination and localization. It is probable that these two types of sensibility represent distinct stages in the evolution of cutaneous perception. According to Head[4] and Holmes, the rela-

[3] Cf. *The Evolution and Dissolution of the Nervous System*, 1884.

[4] Cf. *Brain*, 1911–12, Vol. 34, p. 112.

tion between protopathic and epicritic sensibility is analogous to the relation between the cerebral cortex and the optic thalamus.

The psychological implications of this inhibition by the cortex of the tendency toward affective over-response by the thalamus have been drawn by W. H. R. Rivers in his book *Instinct and the Unconscious.* Rivers believes that these two systems are not only distinct anatomically, but separate in date of acquisition. This example of the repression of mass reflexes of the lower level by higher centers is a common occurrence. In some cases, Rivers states, *it seems that we are dealing with the suppression in the race of experience belonging to an earlier phase of evolution.* This point suggests that racial suppression is repeated in every individual as part of the recapitulation of racial history.

In cases of purely functional disorders, there may be no discoverable degeneration of nervous tissue to parallel the psychic regression. From the fact that in some cases a permanent cure can be produced through proper treatment, it would appear that psychic regression need not be accompanied by somatic degeneration. But even in such cases physiological concepts may be applicable. Here we think of the theory of E. S. Cowles, who links nervous exhaustion, melancholia, and mania into a descending chain, each link representing a level of energy availability. The idea here is that the step from melancholia to mania is always a drainage of energy downward, and that in recovery the individual must pass, perhaps briefly, through melancholia and a stage of nervous exhaustion back to the normal. Prior to this theory, Ribot had emphasized the fact that regression represents an economy of effort in reacting to a situation which is too difficult to cope with otherwise. From this point of view religion, with its emphasis upon the Fatherhood of God and the infantilism of man ("Lest ye become as little children"), is a regression. "Split" personalities, involving the dominance of a more juvenile self, also represent an easier way of reacting. Freud carries this tendency toward refuge in childhood reactions much further back. He believes that this tendency toward a reinstatement of an earlier condition has its first manifestation in the instinct of life to return to the lifeless matter out of which it originated. Thus in his book *Beyond the Pleasure Principle*, Freud is led to the paradoxical hypothesis that "the goal of life is death."

Objections to this type of theory are, of course, not wanting.

One objection is that the doctrine of recapitulation—that the child retraces the steps of racial development and as an adult may later revert to an earlier stage—must be modified to take into account the fact of "short cuts," and the important influence of the immediate social environment. Another and more serious objection arises out of the following circumstance. It is clear to the well-informed that the doctrine that in his individual mental development each human being passes through the stages of previous phylogenetic evolution resembles the biological doctrine of the inheritance of acquired characteristics. The theory of "psychic recapitulation" and the "culture epoch" theory correspond rather strikingly to Haeckel's famous biogenetic law, according to which ontogeny recapitulates phylogeny. To be sure, many who accept this generalization as being approximately correct have not been blatant advocates of the Lamarckian doctrine. Nevertheless, some psychoanalysts who regard the unconscious of the individual as the epitome of the phyletic heritage specifically ally themselves with the doctrine of the inheritance of acquired traits (experiences). This then throws the doctrine open to all the criticisms leveled at Lamarck's theory of the effects of use and disuse. Before considering this difficulty, let us see how the Lamarckian theory has functioned in those systems that have tried to trace a fundamental connection between heredity and biological memory.

III. Heredity and Biological Memory

The similarity between memory and heredity has appealed to a number of thinkers. So far as I am aware, Samuel Butler's work on *Unconscious Memory* (1880) was the first in which an attempt was made to demonstrate a connection between these two conservative factors. Ewald Hering's work *On Memory as a General Function of Organized Matter*,[5] where he developed the notion of memory as a general property of organic tissue, was one of the most original attempts at working out a systematic conception of the relation between memory and heredity. Hering states: "Through frequent repetition, one particular kind of function becomes, as it were, the second nature of a single cerebral cell, *i.e.*, the cell acquires this special ability or energy. In this way the individual energies of the cerebral cells and fibers are developed by education on the basis of inherited dispositions. Also the additional energy,

[5] English translation, 1895.

which the cells acquire during life, is transmitted by inheritance to the new-formed cells which are generated by partition. These new cells can in turn develop, evolve, or modify the inherited energy." Writing before the appearance of Mendelism, Hering supposed that the living germ-substance for each animal species had its specific properties or energy. Thus the "specific energies" theory, first formulated by Johannes Müller, is linked with the theory of the inheritance of acquired characteristics.

The next important development of this theory was presented by Richard Semon in his book *Die Mneme* (1904). Semon's conception of phyletic memory, as exhibited in instincts, habits, and "pattern reactions," is based on the idea that etchings on protoplasm by external stimuli leave certain reaction tendencies called "engrams." These are built up by the repetition of stimuli and passed on through evolution. Memory is a complex synthesis of engrams.

The work of Eugenio Rignano, *Sur la transmissibilité des charactèrs acquis*,[6] constituted a further stage in the development of the doctrine. Rignano's view is interesting because he tries to be more specific in providing a mechanism that will bring together the facts of heredity and memory. Rignano's hypothesis assumes the existence of "specific nervous accumulators." The fundamental idea is that every functional stimulus is transformed into a specific vital energy, and deposits in the nucleus of the cell a specific substance capable of discharging in an inverse direction as soon as the dynamic equilibrium of the organism is restored. These specific nuclear substances, different for each cell, are accumulated also in the nuclei of the germinal substance, constituting what Rignano calls the central zone of development. In other words, each functional adaptation changes slightly the dynamic equilibrium of the organism, and this change in the system of distribution of the nervous currents leads to the deposit in the central zone of development of a new specific substance. In the development of the next individual, this new specific element enters into activity and reproduces the nervous current that formed it, as soon as the organism reaches the same condition of dynamic equilibrium as obtained when the stimulus acted on the parent. Development can thus be regarded as consisting of a number of

[6] Paris, 1906.

stages, at each of which new specific elements enter automatically into play and lead the embryo on from that stage to the next.

Although this view has appealed to some investigators, most biologists are unable to accept its tenets. Professor C M. Child, for example, has pointed out to the writer that Rignano's conception assumes the truth of the dubious doctrine of the specific energies of the nervous system. But aside from these theoretical difficulties, there is the question of the empirical evidence in favor of the Lamarckian hypothesis upon which the view of Rignano, no less than the similar views of Hering and Semon, rests. The problem of adjusting the theory of psychic recapitulation to the Lamarckian hypothesis is one we now turn to.

The conclusion that seems to be implied in the foregoing discussion is this: If one believes in the doctrine of the transmission of acquired traits (including habits, repeated until they acquire engrammatic character), it is natural to believe that psychic regression in the individual is an atavistic reversion to a more primitive level of biological memory. But now we come to the real problem. If one is convinced of the fact of psychic recapitulation, does this carry with it as a necessary logical consequence the acceptance of the doctrine of the inheritance of acquired characteristics? It seems to me that the answer to this question is No. A critic with an eye open to all the possibilities might point out that we are here not faced with a true disjunction. It is not a case of accept Lamarck and you can have mental recapitulation; reject Lamarck and recapitulation is rejected with it. It may be pointed out that there are other possibilities. The hypothesis of parallel induction,[7] for example, admits of the possibility of the appearance in subsequent generations of structural modifications that *apparently* are a result of the functioning (experience) of the organism, but *in fact* are a result of changes that occurred simultaneously in the somatic and germ cells, without there being any causal interaction between bodily activities and the genetic units. This is mentioned merely as one possibility; other alternatives are perhaps conceivable. At any rate, the ideas developed by Head and Rivers do not appear to rest on the Lamarckian hypothesis.

It is, of course, proper to point out that even if it should be

[7] For a discussion of this notion see Seba Eldridge's *The Organization of Life*, *passim*.

proved that there is a necessary connection between psychic recapitulation and the transmission of acquired characteristics, this does not absolutely invalidate the explanation of psychic regression. The common objection to Lamarck's doctrine, that no mechanism has ever been discovered (or is even conceivable) whereby individual experiences and the accompanying somatic modifications can influence the germ plasm, and thus become transmitted as hereditary effects, is in fact no objection. William McDougall is quite correct in stating that even though we cannot visualize how a process takes place, this is no reason for denying that it happens. As a matter of fact, as previously noted, J. J. Cunningham, in his book on *Hormones and Heredity*, has suggested that these very potent "chemical messengers" may be the formative stimuli and bearers of racial memories, and thus supply a possible mechanism for the interaction.

These considerations should serve to make us sufficiently open-minded about the Lamarckian hypothesis, so that we can consider the theory of psychic recapitulation and mental regression on its own merits. But there is another approach to this matter, and since it promises to throw light on some dark corners of science, we pursue this path for whatever it may be worth.

IV. Structure and Function

By way of approach let us first point out that the theory of psychic recapitulation is arrived at through *reasoning by analogy.* It is generally known that this type of reasoning may be put in the form of a proportion, as follows:

$$\frac{A}{B} = \frac{C}{D}, \text{ or } \frac{\text{Old problem}}{\text{New problem}} = \frac{\text{Old solution}}{\text{New solution}}.$$

This is usually the form that reason follows in arriving at new hypotheses, which are tentative solutions to problems. This pattern is the conventional guide because solving problems, adapting ourselves to novel environments, is a matter of *transposing* an adequate response to some old situation to the new stimulus pattern. As the writer has shown, the theory of intelligence presented by gestalt psychology rests upon reasoning by analogy, for when you transpose an old gestalt into a new situation you are transposing a set of relations. Such a gestalt as a musical phrase

consists of the *relations* between the notes of the musical melody of which it is composed, and the transposed melody possesses a similarity of structure (isomorphism) paralleling the old melody.

This notion of relation structure is coming to be recognized as a concept fertile in its applications. Bertrand Russell points to its epistemological significance in the following lines:[8]

> We naturally interpret the world pictorially; that is to say, we imagine that what goes on is more or less like what we see. But in fact this likeness can only extend to certain formal logical properties expressing structure, so that all we can know is certain general characteristics of its changes. Perhaps an illustration may make the matter clear. Between a piece of orchestral music as played, and the same piece of music as printed in the score, there is a certain resemblance, which may be described as a resemblance in structure. The resemblance is of such a sort that, when you know the rules, you can infer the music from the score or the score from the music.

L. T. Troland sees in this principle a possible clue to the solution of the problem of the relation of brain and consciousness. After stating the general principles governing the relation between the two, Troland sums the matter up as follows:[9]

> All of these principles can be combined into the general statement that consciousness and the brain mechanism which underlies it have a similar logical *formula*. As an example of the meaning of this statement we may consider the case of a motion picture and a novel, both of which portray the same story. . . . A piece of music as played by a pianist and the score which he has before him are radically different things, and yet they have a corresponding structure.

The way in which this similarity of "structure" enables us to relate mental and cerebral processes is a matter we have dealt with in a previous volume. Here we are concerned primarily to point out that the notion of "insight"—which the "gestalters" make so much of—as a case of analogical reasoning (transposing relation-structures) finds support in the view of L. L. Whyte, who states that "intuition is the recognition of the similarity of relation-structure in two situations, and reasoning the tracing of the

[8] Cf. *The A B C of Relativity*, 1925, p. 227.
[9] Cf. *The Mystery of Mind*, 1926, p. 203.

consequences of this similarity."[10] It thus appears that creative thinking follows a simple formula, a pattern that comes naturally out of the principles of gestalt psychology. Developing this view, the writer has proposed that the principles of gestalt psychology may be fitted into the schema of the Hegelian dialectic as reinterpreted in terms of the contemporary theory of emergent evolution.

And now we consider the implications of this for the problem of the structuralization of function, the problem of biological memory. Since reasoning by analogy, or the transposition of *Gestalten* (or isomorphic relation-structures), is the method of gaining hypotheses, the hypothesis gained in this particular case must exhibit a pattern similar to our formula. This is indeed the case, for the doctrine of psychic recapitulation may be formulated as follows:

$$\frac{\text{Individual mental evolution}}{\text{Racial mental evolution}} = \frac{\text{Individual biological development}}{\text{Phyletic evolution}}.$$

Now if it is true, as we maintain, that reasoning is the cerebral counterpart of the general biological differentiation of part-patterns within larger wholes (as G. E. Coghill's work suggests), while evolution, on the other hand, is the phylogenetic counterpart of the self-transcendence evident in thinking as it moves on to new organismic integrations, then it follows that mental evolution recapitulates racial evolution (except for short cuts) because body (mutations excluded) consists of conventionalized behavior (structuralized energy fields). In brief, structural *Gestalten* are simply crystallized functional patterns.

With these principles in mind, we return to the subject of biological relativity.

V. Biological Relativity

Poets have frequently compared life to a candle. The analogy is a good one, for life is literally a process of combustion, and oxidation is the flame of life. The thesis of the chemist, that when one substance is oxidized another is reduced, applies as well to organic reactions as to inorganic processes. Oxidation and reduction are complementary processes, occurring in conjunction.

[10] Cf. his *Critique of Physics*, 1931, p. 163.

Since the organism is able to facilitate these oxido-reductions between different substances, it is perfectly correct to regard life as an oxidation-reduction rhythm.

Many thinkers have pointed out the rhythmic character of the life processes. One of the finest expressions of this rhythmic nature has been given by A. N. Whitehead in his *Principles of Natural Knowledge* (Chapter 18), but Dr. Whitehead makes no suggestions about the physiological underpinning of the rhythm which is life. However, the fact that it is this interplay of oxidation and reduction which accounts for so many synthetic reactions of protoplasms certainly lends credence to the idea that the rhythms of life are oxido-reductant rhythms.[11] The power of living matter to carry on such oxidative and reductive transactions is dependent upon the presence of biocatalysts. Among such catalysts are the enzymes, water (which has the ability to facilitate organic reactions), and radiations (light).

It is now generally recognized that the oxidation-reduction reactions of protoplasm are at bottom electrical responses, involving the transfer of electrical charges. Starting from the conception that all processes of oxidation involve the transfer of negative particles from one element to another, the one that receives the negative charge being reduced and the element losing it being thus rendered more positive and being said to be oxidized, we arrive at the conclusion that every bioelectric process involves a minute action current, as the charge is passed from the oxidizing to the oxidized body.

This idea has been developed in a systematic form by E. J. Lund,[12] who believes that the electric polarity of the cell is quantitatively correlated with the respiratory exchange of the cell, and that electric currents accompany cell oxidation. Thus bioelectric currents are held to provide the basis for cell correlations.

[11] In his book *Protoplasmic Action and Nervous Action*, R. S. Lillie states (p. 403) that "growth, repair and recovery from stimulation are the result or expression of chemical reactions, of the same general kind, apparently oxidative syntheses, which occur predominantly at the polar region. This view is entirely in accordance with the theory of C. M. Child that regions of higher metabolic rate control those of lesser rate. Thus in his book on *The Origin and Evolution of the Nervous System*, Professor Child concedes (p. 84) that if oxidation and synthesis are associated, the physiological gradients are determined by regions of higher metabolic rate.

[12] Cf. "Relations Between Continuous Bioelectric Currents and Cell Respiration, V," *Journal of Experimental Zoology*, 1928, Vol. 51, pp. 327–337.

Lund has also advanced the idea that the bioelectric currents produced by the cells are the expression of oxidation-reduction potentials. He holds that stimulation changes the electric potential and therefore the electric polarity of the cell, because it temporarily accelerates the reaction reductant → oxidant, and thus changes the *ratio* of oxidant to reductant. This is quite in line with our own theory of the physiological basis of psychological relativity. We have already noted that, while psychologists still talk about one set of neurones doing one thing and another set doing something else, actual results indicate that the same cortical tissue may be both active and passive at the same time. That is to say, cerebral action currents are such only by virtue of a difference of potential at a given time, and whether such a bioelectric current will occur depends upon where one electrode on the cortex is with respect to the other. This relativity of action currents, we hold, is a manifestation of the biochemical relativity of the oxidation-reduction rhythms (redox-potentials).

In the human being these oxidative reactions go on most rapidly in the brain, which is the vehicle of consciousness. The extreme sensitivity of cerebral activity and of consciousness to oxygen deprivation points to the exceptionally high rate of metabolic activity in nervous tissue. Why, then, we ask, should we not consider the facts of psychological relativity, so obvious in the case of sensory perception (such as, simultaneous color contrast) as a phase of the relativity of cerebral action currents to the total state of the brain as a whole, including the residuum (hysteresis) due to past experience? In Lund's view the reaction velocity (reductant → oxidant) is a result of a *ratio* (proportion) of the electric potential, and this makes it a relative matter. The notion that oxidation-reduction is an instance of what W. H. Manwaring[13] terms "biochemical relativity" is intimated by F. Knoop[14] when he states that probably every organic substance in the body has *in relation to every other* a certain redox-potential, which will vary according to conditions, for example, of the hydrogen-ion concentration, temperature, oxygen concentration, the catalysts present, etc. Thus we have a bioelectric relativity paralleling the psychological relativity that the gestalt psychologists have

[13] *Science*, 1930, Vol. 72, p. 25.

[14] "The Mutual Influence of Organic Compounds in the Animal Body," *Science*, 1930, pp. 23–25.

emphasized. The manner in which this bioelectric relativity might explain the "attraction" of two "similar" mental processes for each other was suggested in the previous chapter.

These ideas, we hold, are entirely consistent with our espousal of certain of the concepts of psychoanalysis. No one has yet attempted a synthesis of psychoanalysis and gestalt psychology. When and if such a synthesis is achieved, it seems to me that it will come by way of the notion of biological relativity. Here are a few suggestions looking toward such a unification.

We start with the observation of Dr. K. S. Lashley[15] that the dynamic conceptions involved in the doctrine of the libido, psychic censor, and other mechanisms essential to the explanation of repressions, sublimation, etc , resemble more closely the behavior of liquids under pressure than they do any recognized physiological processes. He therefore dismisses these psycho-hydraulic analogies, arguing that the "neurine" of Wm. McDougall and D. F. Harris, the "dammed up" energy of R. S. Woodworth, and the "drainage" hypothesis are not in harmony with the recent work on the propagation of the disturbance in nerve fibers. Unfortunately Dr. Lashley overlooks the fact that there are many analogies between hydrodynamics and electrodynamics, and that if one has an electromagnetic theory of brain activity, all of these psychoanalytic concepts can be fitted into the picture.

The relativity (in our theory the bioelectric relativity) of the processes that underlie the psychoanalytic theory is illustrated by such notions as "repressions." Whether the "pressure" exerted by the psychic censor to repress an experience or tendency is sufficient to keep it below the "surface" of the stream of consciousness depends upon the *relative strength of the impulse in relation to the force of resistance or inhibitory power.* Here we are dealing with a dynamic situation. Pavlov's work on conditioned reflexes has shown that it is the cerebral cortex, with its powers of inhibition, that compels the co-operation between otherwise independent nerve centers. At the end of the process of evolution in the human animal it is the visual areas that have come to dominate the conscious realm to a much larger extent than in lower animals, where the brain is more of a smell organ. But this fact

[15] "Physiological Analysis of the Libido," *Psychological Review*, Vol. 31, pp. 192–202.

does not justify the customary statement that in human beings the sense of smell has degenerated in favor of the distance receptors. Smell has been *repressed*; but when the cortical pressure is removed, there may be a reversion to the more primitive level. Anyone who has studied epileptics psychoanalytically gets an excellent idea of how unrepressed smell comes into its ancient own in erotic sadistic activities. This fact has been pointed out to me by Dr. Smith Ely Jelliffe, and he also argues that "repressions" are not always from the cortex, but may be present from any level downward. In emergent terminology: life processes can repress matter processes, mind processes life processes, social processes mind processes, etc.

The notion that psychic relativity arises out of the relation of part-processes to the whole has been proposed by Theodor Lipps[16] as an explanation of Weber's law. The present view restates this notion in the thesis that, in addition to the "local" bioelectric currents, there is some all-inclusive field associated with the living organism. As Julian S. Huxley[17] points out, various experiments reveal that a "morphogenetic field" permeates the whole body. It is normally a by-product of the animal, but in cases of regeneration, etc., it reveals its presence by its effect upon the differentiation of new material. According to Professor Huxley, whether such morphogenetic fields and the fields of growth gradients are both manifestations of the same organismal field, or whether two essentially different field mechanisms are at work, is still a problem. In either case, we may still agree with Darcy W. Thompson's[18] suggestion that a comprehensive field of force running through an organism somehow shapes it, independently of the individual cells that enter like froth into its fabric. This all-encompassing field the writer has variously called a "superior co-ordinating force," a "macroscopic rhythm," etc.[19]

[16] See his paper "The Law of Psychic Relativity and Weber's Law," in his *Psychological Studies*, Baltimore, 1926.

[17] Cf. *Problems of Relative Growth*, 1932, p. 153.

[18] *On Growth and Form*, p. 200.

[19] In some respects there is a similarity between the author's views and the ideas advanced by Professor F. S. C. Northrop, who has also sought to explain biological phenomena in terms of field physics. But Professor Northrop's view, which is still in course of development, excludes the notion of an absolute time, whereas the present view aims to reconcile the absolutivity and the relativity of time. Dr. Northrop's theory, first systematically

The mode of interaction between local processes and the mind is held to be through the electromagnetic field. To the objection that the fields of force which must necessarily accompany the electromotive forces present in cerebral reactions (now termed electroencephalograms) cannot be very strong, we have already replied that such superior co-ordinating fields may be strong enough to initiate processes that then proceed on their own potential energy. Thus we conclude that "we seem to be a little closer to the distant goal of understanding how superior mental patterns superimpose their fields of force upon the quantum-colloidal configurations and activate their subordinate molecular fields, thereby guiding and modifying the bodily mechanisms of behavior. The macroscopic field of consciousness emerges out of its microscopic constituents, but in turn it lives to dominate its subordinate rhythms through the electromagnetic bond of fealty which unites body and mind."[20]

---

expounded in his book *Science and First Principles* (1931), has recently been stated in his article "Causality in Field Physics in Its Bearing upon Biological Causation," *Philosophy of Science*, 1938, Vol. 5, pp. 166–180.

[20] Quoted from the author's *Philosophy and the Concepts of Modern Science*, p. 172.

CHAPTER FIFTEEN

RÉSUMÉ: SPACE, TIME, MATTER, AND ORGANISMS

It is impossible to meditate on time and the mystery of the creative passage of nature without an overwhelming emotion at the limitations of human intelligence.

—A. N. WHITEHEAD

I. FROM THE GREEKS TO EINSTEIN

Time, space, and matter are the most pervasive and inescapable aspects of the physical universe. And yet, notwithstanding the fact that they represent the most fundamental and ubiquitous characteristics of reality, they have always presented elements of mystery to the human mind. Thus on the level of common thought we ponder how the withering hand of time reaches from out from the past into the future to bring decay and destruction to all things; and on the more sophisticated level, after the fashion of Immanuel Kant, we are puzzled by certain antinomies of thought concerning the necessity for an origin and an end of the universe in time and in space, in the face of the equally necessary reasons for regarding the universe as being unlimited in its space and time dimensions. In either case, however, we are paying tribute to the tantalizing nature of these problems concerning the cosmic framework of space-time-matter in which we live and move and have our being. Indeed, it is not too much to say that genuine philosophy took its origin in Zeno's paradoxes of motion, and will have its final consummation when it solves Kant's antinomies.

It is well known that in attempts to solve what we may term the time-space-matter problem, there has been a persistent tendency in philosophy and in physical science to regard change as unreal and irrational. The ideal pattern for science, as Émile Meyerson has shown, is provided by the Parmenidean conception of a timeless and changeless universe. The Einsteinian reduction of physical reality to spatio-temporal coincidences is the modern restatement

of this doctrine. And yet, whether from the side of mere common sense, which ridicules Zeno's proofs of the impossibility of motion, or from the side of biological evolution, or from the irreversible changes in physics due to the second law of thermodynamics, change *will* force itself into the picture and change it at least into a movie film. How to bring together the conceptual world of thought and the perceptual world of growth and motion still remains one of the main problems of the philosophy of science.

But while these problems are still with us, it cannot be said that we have not made progress in our treatment of them. In earlier philosophy the question of the eternity of matter was not supposed to be connected in any way with the problem of the finite or infinite nature of space, or the limited or unlimited nature of time. Moreover, space and time were commonly supposed to be independent of the "matter" which "filled" them; space and time were supposed to be the containers within which matter was put, without disturbing any of them. In classical physics this view appears in Newton's theory when he regards time and space as absolute, each preserving its virginal nature throughout all cosmic vicissitudes.

Now all this is changed. We have learned that the old assumption—that these three aspects of the cosmic trinity, time-space-matter, are independent of each other—is false, and that if we are to speak in terms of a trinity we must introduce the notion of intercourse and fertility to understand the relations of the members of this union. For physics now presents the picture of a universe in which all three are intimately related. Since the work of Einstein, Newtonian physics has been radically modified; physical science has adjusted itself to the revised notions, and is rapidly forging ahead formulating new insights. But in philosophy the implications of the new science have not been fully developed. It is known that Kant's view, that time and space are a priori forms which the ego superimposes upon the external world, was based largely upon the universal acceptance of the Newtonian-Euclidian world picture. While physicists have emancipated themselves from this view *in their own field*, all of us, scientists and philosophers alike, are still profoundly influenced by the set of habits of thought which Kant helped to stabilize. But even in philosophy a reconstruction has been in progress. In general

there has been a common trend toward an organic view of nature. In astronomy this appears in the notion, for example, of an expanding (or expanding-contracting) universe, *the radius of which varies with time.* Does this not imply some organic connection between the members of the trinity, matter-space-time?

In the present Part II we have made an attempt to deal with the time-space-matter problem in terms of this organic view of nature. Before epitomizing this view, it is desirable to restate certain of the fundamental definitions we have found it necessary to employ.

II. Restatement of Definitions

Since it is now recognized that space, time, and matter are abstracted aspects of a universe that is spatio-temporal-material, it is clear that it is impossible to define any one member of the trinity without implicitly introducing the other two. This situation leads to circular definitions—unless we assume an intuitive understanding of the meaning of each term and leave them undefined. An "operational" theory of concepts does not escape this problem, but is merely one way of delimiting the range of application of the terms to be defined. Here, then, are the important concepts.

Space.—Leibniz's definition of space as the order of co-existence of things may be restated as follows: space is the order of relatedness of positions of objects taken at any given instant from some point of view. Thus space is not a "receptacle" or a "thing-in-itself." Space might be defined as the possibility of motion of matter, provided it is recognized that since motion is relative, space also is relative. Even the shape (spatial contour) of an object is relative: thus a spherical body appears to be flattened when viewed from a system moving at right angles to it.

Time.—Physical time is the order of succession of external phenomena. It is the one-dimensional direction in which all events are aligned. Velocity is the measure of the time-rate of change of motion. Velocity, like acceleration and force, is relative. Therefore, except for bodies in contact, *now* ("simultaneity") is ambiguous. That is to say, physical time is a measure of the change of a system as observed from some external point of view, and varies from one "frame of reference" to another. But it is also assumed that in certain systems which undergo change, *this change is experienced subjectively as temporal passage.* This ex-

perience constitutes psychical time, and under these conditions "time is the mind of space," as Alexander says.

Matter.—According to the present theory matter is any pattern of electrical density which—from a system at rest with respect to it—maintains itself in the same region of space in time. Some authorities have tried to make of energy a more fundamental reality than matter. On any given level above the "floor" of nature we hold that "matter" is the structural aspect and "energy" represents the functional aspect, so that they are here correlative and inseparable; but this permits of the "emergence" of matter in the sense that energy of a radiational or field type may be transformed into a relatively discrete (corpuscular) nature, and these may aggregate with other such corpuscles into more complex bodies (matter). This transformation of energy into matter, waves into corpuscles, is something that cannot be explained in terms of the Aristotelian laws of thought.

Gestalt.—A *Gestalt* is a spatio-temporal organization, or pattern, of matter in which the relations are internal to each other—that is, there is an interaction between the parts and the whole. These new patterns which thus emerge are non-additive wholes to which linear equations are inapplicable.

Organism.—An organism is a whole composed of interacting *Gestalten.* In this sense atoms, and possibly the cosmos itself, are organisms, of which space, time, and matter are abstracted aspects. J. H. Woodger tells us[1] that in order to have the wholeness characteristic of an organism there must be an internal relatedness (an inner necessity more or less autonomous, according to gestalt theory) between the parts and the whole. This is summarized by Professor Whitehead in the following lines:[2] "The concrete enduring entities are organisms, so that the plan of the *whole* influences the very characters of the various subordinate organisms which enter into it. In the case of an animal, the mental states enter into the plan of the total organism and thus modify the plans of the successive subordinate organisms until the ultimate smallest organisms, such as electrons, are reached. Thus an electron within the living body is different from an electron outside it, by reason of the plan of the body." White-

[1] "The 'Concept of Organism' and the Relation Between Embryology and Genetics," *Quarterly Review of Biology*, 1930, Vol. V, p. 449.

[2] Cf. *Science and the Modern World*, 1926, p. 115.

head constantly stresses the fact that the notion of "nature at an instant" is an abstraction; that it requires time for a thing to exhibit its properties; and that a thing is "social" in nature because it requires an environment to "be" itself. Thus the organic view avoids what we would describe as the Aristotelian-Newtonian fallacies of "simple location" and "misplaced concreteness."

III. Physical Assumptions

The following theses summarize the naturalistic conditions which are regarded as necessary in order that there can be a *time sense* in organisms:

(1) *There must be an organism in an environment.*

(2) *There must be a relative motion (or motions) of the environment (or some part of it) with respect to the organism.* As we have previously seen, this is illustrated by the Doppler effect, either for sound or for light, where the quality of the resulting "sensation" depends upon this relative movement. In general, a variation in motion of the observer with respect to the source of the stimulus, considered as stationary, produces the same effect as an objective variation of the stimulus attributes when the observer is at rest with respect to the source of the stimulus. Once we are adapted to a stimulus, it usually requires another relative change of the stimulus attributes to produce another sensation, pain being the only sensation to which we cannot become accommodated. Even the sense of motion in an elevator (due to the statoliths) depends upon a relative change of velocity.[3]

[3] At this point we can conveniently discuss the case of the (hypothetical) individual who starts on a journey to one of the distant stars, traveling with the velocity of light. It is usually said that for such a person time stands still, so that the individual appears to grow no older so long as this velocity is maintained. When a body travels at such a velocity, time measurements become infinitely long and duration ceases to exist. This is true from an external viewpoint; but in terms of subjective discriminations, even on the theory of relativity, a being traveling with the velocity of light might have a sense of temporal passage, provided there still were internal rhythms. This statement is in accordance with the relativity idea that *there is no necessary causal connection between the inner processes which occur within a physical system and the movement of that same system as a whole.* The rate of change within an organic system (one with a time sense) is not *necessarily* altered by the motion of that system, so that one's sense of temporal passage, in so far as it depends upon the discrimination of internal rhythms, would not be affected. This does not exclude the possibility that a relative movement of the system as a whole *may* modify the internal structure, as in the case

(3) *But not all motion yields (causes) a sense of temporal passage.* Those objects (as a pendulum) that cannot discriminate change, because there is no integration of subjective rhythms, have no time sense.

(4) *There must be some complexity of structure to produce a time sense.* By definition, every organism has a time sense, and everything that has a time sense is an organism. The need for complexity of structure arises from the fact that experienced time is a *Gestalt*, like a melody. In man this complexity of structure involves both the interoceptors and the exteroceptors.

(5) *There must be an interaction between subjective and objective rhythms* Although the complex organism has rhythms of functioning of its constituent organisms, the time sense emerges as a result of the interaction of internal and external rhythms What is an internal rhythm from one point of view (as the heart beat) may be an external rhythm from another point of view.

(6) *In every organism that which is externally observed as a movement can be said to be internally perceived (experienced) as a passage of time.* Here we agree with Bergson that time as experienced and time as measured may not coincide quantitatively, but we deny Bergson's thesis that experienced time (duration) does not inhere in physical reality. As Josiah Royce suggested, we may not be able to communicate with lower organisms (inorganic and organic for us) because our time sense, or rhythm of attention, may be different.

(7) *The wholeness of every organic system has associated with it a subjective phase that is experienced as the passage of time.* This is due (*a*) to the intrinsic nature of the component rhythms of the system itself, and (*b*) to the relation of this subjective unity to the external rhythms and events of the cosmic environment. Thus the time span of events, of *subjective duration* and *objective physical motion*, is relative. In general, as we have pointed out, there are three types of relativity: (1) physical relativity, (2) biological relativity, and (3) psychological relativity. Each of these represents a kind of hysteresis of the next lower level, which provides the structural basis of the relativity. Thus psychological relativity is conditioned by biological constitution (a kind of phylogenetic hys-

---

of a plant or photographic plate, which could be moved rapidly toward a source of red light, in which circumstance the plant and the photographic plate could, respectively, undergo the chlorophyllian and the photochemical reaction. Here again the Doppler effect is in operation.

teresis), while biological relativity is a special case of history as recorded in physical structures that have preserved some residuum of past environmental influence. Thus, except for the "ultimate material constituents" (if any), physical structure is crystallized function, behaving in accordance with the "habits" preserved in experience.

IV. Organic Time

If the present view is correct, anyone who propounds a theory of biological time and psychic time must assume some theory of the nature of time as it must be understood in physical science. The only other recourse would be to throw overboard the doctrine of evolution and hold that experienced time is of no kin to time as it enters into the study of "inorganic" phenomena. This doctrine that both orders, the objective (physical) and subjective (psychical) time, are ultimate and irreducible has of course been put forth. But this is to create a rift between the physical and the psychical, leaving us with a dualistic philosophy similar to Bergsonian vitalism. In the faith that it is possible to develop in physical science a tenable theory of time that will bridge the supposed gap separating "mechanical" behavior from "purposive" behavior, and at the same time provide a conception of the origin of psychic time, we enter upon this next section by considering first of all the various differentiating features that have been suggested as uniquely characterizing organic or vital systems.

Some biologists, attempting to find a criterion for distinguishing between animate and inanimate behavior, have found in the *historical* character of organic phenomena a differentiating property. Borrowing a term from Alfred Korzybski, the advocates of this view might say that organisms are "time-binders." Thus L. V. Bertalanffy has argued[4] that this historical character is quite foreign to physics, since physical equations are of such a kind that the state of the system for which they hold is determined solely by the present conditions of the environment, regardless of the previous history of the system. But by way of replying to this view, we may point out that this idea is flatly contested by N. Rashevsky, who has shown[5] that "learning by experience"

[4] "Philosophie des Organischen," *Lit. Ber. a. d. Geb. d. Phil.*, 1928, No. 17–18.

[5] "Learning as a Property of Physical Systems," *Journal of General Psychology*, 1931, Vol. 5, pp. 207–229.

may be a property of physical systems, and that organic memory has its prototype in hysteresis phenomena in physics.

A second criterion of organic processes is said to consist in the fact that the notions in biology of metabolism, function, protoplasmic gradients, etc., imply an asymmetrical temporal relation that has no duplicate in physical processes. Such statements as this, that "life is the sum total of forces making for irreversibility," have been taken to mean that physical transactions are two-way processes (to use G. N. Lewis's term), while organic processes imply a "one-way" time system. In disposing of this view we need only emphasize that time in physics has no single and unambiguous meaning, and that *some* physical processes, notably those that proceed in accordance with the second law of thermodynamics, may be unidirectional or irreversible. Moreover, such notions as "stellar evolution" and "atomic evolution" certainly introduce the notion of the asymmetry of time, and this is not nullified by the recognition of the inverse phases of these processes.

We have stressed the fact that all continuants of nature are space-time-matter entities. These complexes of behavior-stuff, by a process of abstraction, are susceptible of analysis into spatial and temporal co-ordinates. In some cases it is convenient to concentrate on the spatial aspect of the polyphasic colloidal systems known as the protoplasms. Thus, as J. H. Woodger points out, anatomy studies the organism in timeless space. But this must not lead us to neglect the fact that the organism is an historical being as well as a spatially extended thing. As a durational creature, an organism is enregistered; in its engrams and biological memory history is recorded. In a living organism (as opposed to "inorganic" organisms) more of the past is preserved than in non-living beings. In man the phyletic effects of previous biological evolution manifest their influences through what von Hartmann and the psychoanalysts term the unconscious. The writer has tried to show how such psychic reactions as are present in religion may be explained in these terms.

The subject of time in relation to organic functioning has been studied by Dr. Alexis Carrel, and the following passage[6] is quoted to show what the results indicate:

[6] "Physiological Time," *Science*, 1931, Vol. 74, pp. 618–621.

The body really consists of a flux of structural and functional processes, that is, of uninterrupted modification of tissues, humors and consciousness. Such is physiological duration. The process of aging starts simultaneously with embryonic life. It is expressed by irreversible changes progressing during the entire span of our existence. The decrease in rate of growth during infancy and youth, the occurrence of puberty and menopause, the lowering of basal metabolism and the modification of the skin and hair, etc., appear as the stamp of time on the organism. Most of these phenomena either occupy a relatively short period of duration or are not susceptible of sufficiently precise measurement. Fortunately, other physiological and chemical processes taking place in tissues or in blood plasma have been found to be measurable during a considerable part of the life span When small fragments of tissue are removed from an animal and placed in a medium practically deprived of nutrient substances, they manifest some activity and for a few days increase in size. The length of the period of growth and the velocity of the process can easily be ascertained. They express the residual growth energy of the tissues. In an embryo, this residual energy is greater than in a new-born animal. It continues to decrease during youth. But the aging of the organism can not be traced during the whole life by this method because the differences in the growth energy of the tissues of adult and old organisms are too small to be accurately detected. Moreover, each type of tissue appears to record time in its own way. A more definite effect of time on living structures is obtained when one studies the variations of the rate of healing of a wound in function of the age of a patient.

In this last statement Dr. Carrel has in mind du Noüy's equation, the nature and basis of which are explained by P. Lecomte du Noüy in his recent book *Biological Time* (1937).

V. Psychological Time

Not only is the temporal sequence of nature one of the most puzzling phases of the objective world, but the sense of temporal passage is one of the most baffling aspects of the subjective world of human experience. Like the problem of space perception, the problem of the perception of time remains one of the old, and ever-new, riddles of psychology.

The sense of time is bound up with the idea of sequence, the irreversible series of "instants" which are so ordered as to enable

us to recognize and place events as "before" and "after." The unidirectional character of experienced time is illustrated in several ways. For example, one is free to journey back and forth in space, as from America to Europe; but one cannot journey backward into last week, except in memory, and one cannot journey forward into next week, except in imagination—though this latter statement is in a sense false if such experiences as are recounted by J. W. Dunne in his book, *An Experiment With Time*, should prove to be verifiable. A more technical illustration of the one-way character of psychical duration is found in music in the process of chord resolution in melodic and harmonic progressions. It is for this reason that playing a phonograph record backward takes the "meaning" out of it.

And now, we ask, what is the origin of this remarkable time sense?

Psychologists have long debated this matter. Various views are held. One phase of the complex problem of the origin, nature, and locus of the time sense is given in the question, Is this sense innate or acquired? In answer to this question we find here, as in the case of the problem of the origin of space perception, the nativistic and the empiristic views. Kant, who struggled with the problem of passing from a succession of perceptions to a perception of succession, invoked the transcendental ego to explain the "synthetic unity of apperception." Kant held that the source of all synthesis was subjective, and that an innate sense of time is the presupposition of all phenomena and all experience. Since the days of Kant, much progress has been made in biology and sensory physiology, and, under the influence of the empirical and behavioristic developments, Kant's views have fallen somewhat into disrepute. And yet I think it can be shown that in one respect Kant's view is inescapable. If we consider "sensationalistic" psychology, we find an attempt to build up the psychic continuum, the meaningful world of experience, by compounding psychic "atoms" (sensations, images, etc.) into more complex "molecular" mental states. But, let it be noted, in this doctrine of "mental chemistry" we must begin with simple elements that already possess such attributes as "clearness," "quality," "intensity," and "*duration*." This last element of temporal voluminousness is accepted as an innate attribute of the elements of all conscious experience. In this sense sensationalism, associationistic psychol-

ogy, structuralism, and reflexology (the "conditioned reflex" theory of behaviorism) must all agree with gestalt psychology and regard temporal patterns as wholes which are not compounded of parts, or in which, if they are, the parts at least possess their properties as innate attributes not acquired through experience

Perhaps the problem of the origin of the experience of time has seemed more difficult than the parallel problem of the origin of the experience of space perception, for the reason that there is no known sense organ for time perception, whereas space perception is supposed to be more definitely localizable, as in the thalamus, occipital lobe, motor cortex, etc. To be sure, each sense organ may be thought of as a kind of clock. But in addition to this, it is believed by some that there must be a sense organ for time perception independent of the special senses. Thus the Russian physiologist, E Cyon, who finds in the three semicircular canals the organs of the sense of space and the physiological foundations of Euclidian geometry, holds that Corti's fibers are the special organ of time perception. This view may be satisfactory for hearing, though that is debatable, but certainly it cannot suffice for other types of temporal perception. For example, the fact that "filled" time (that is, time during which we are interested in some series of objective events) should be short in passing but long in memory, whereas "empty" time is long in passing but short in memory, suggests that time here is discriminated largely in terms of bodily tensions and relaxations, and that consciousness of muscular sensations (kinaesthesis) plays an important role.

The relative importance of the sensory, cerebro-spinal, and motor aspects of the organism have been much discussed. In recent years some investigators have depreciated the importance of the central nervous system. But in connection with this problem of the perception of time, it seems that William James was correct in seeking for the explanation of the locus of the time sense in some central process. James's view is important and bears restatement. The general explanation that James offers[7] takes its point of departure from the fact of the "specious present" of the organism. As James says, the practically cognized present is no knife edge, but a saddle-back, on which we are perched, and from which we look into the two directions of time. The number

[7] Cf. *The Principles of Psychology*, Vol. I, Ch. XV.

of units that can be brought under one act of consciousness ("span of attention") depends on the grouping of the units. According to James, twelve seconds constitutes the maximum filled duration (as forty strokes in rhythmical groupings of sounds composed of five subgroups of eight units). This grouping is possible because a knowledge of the adjacent parts of the "stream of consciousness," past and future, is always mixed up with a knowledge of the present. The intuition of duration, which James pictures as fairly constant for each passing instant, must be correlated with some fairly constant feature of the brain processes to which consciousness is tied. This brain process James finds analogous to the phenomenon of "summation of stimuli" and after-images. In neural terms, he states, there is at every moment a cumulation of brain processes overlapping each other, of which the fainter ones are the dying phases which but shortly previous were active to a maximal degree. The amount of overlapping determines the feeling of duration occupied. What events shall appear to occupy the duration depends upon just what the overlapping processes are.

Idealists have not been inclined to accept James's version of the unity of the self as the unity of the passing experiences. Mental life, they hold, exhibits the sort of thing that Bergson called "interpenetration," which is not capable of explanation in terms of such metaphors as "overlapping." James admits the limitations of his explanation when he confesses, "Why such an intuition results from a combination of brain-processes I do not pretend to say."

Although at present we know little more about the brain than James did, our knowledge in the field of physics has made tremendous strides, and it would be very significant if the solution to James's problem should be contained in this new knowledge. To indicate the possible liaison between the physical and the psychical would necessitate a digression into the field of vision. We have already struggled with this problem,[8] and the net result of the investigation up to this point has been to strengthen our general theory. In a universal behaviorism, the unit of philosophizing must be the same as the fundamental unit of relativity theory—*action*. Action is energy integrated through time. In

[8] Cf. *The Alchemy of Light and Color* (1928) and *Philosophy and the Concepts of Modern Science*, Ch. IV.

quantum theory this is known as the erg-second, a unit of energy multiplied by a unit of time. In our monism of action we have tried to show that just as in the macrocosm we have evidence that action is the curvature of the world, so in visual phenomena we have evidence that the brain-mind integrates energy through time —and thus we have the clue to the solution of Kant's problem of how to pass from a succession of perceptions to a perception of succession and to James's problem of how an overlapping of brain processes can result in an intuition of duration.

Following Harry Helson's suggestion about the union and co-relativity of psychological space-time,[9] we have concluded that it is possible to interpret psychological phenomena in terms of a mental space-time that is the subjective emergent aspect of the n-fold continuum of relativity physics and wave mechanics. We hold that quantum mechanics and relativity considerations *must* apply to organic phenomena if we are to consider the latter as falling within the domain of physical reality. The only reason for ruling them out arises in connection with the question of whether psychobiological processes are of the right order of magnitude with respect to the space, time, and mass dimensions concerned.

It is interesting to observe that one *can* carry over some notions from physics to biology. Aside from the much discussed question of the bearing of physical "indeterminacy" (Heisenberg) on the psychological problem of "freedom of the will," there is the fact that when you observe a phenomenon in physics you change it (because of the Compton effect), and this consequence has its parallel in biology, where the attempt to study protoplasm in any intimate way results in killing it. Moreover, the fact that the field of the electron extends to infinity, and that two electrons may therefore occupy the same space, suggests a remote physical analogy for Bergson's observation concerning the "interpenetration" of conscious states. Again, if one wants to speculate more boldly, it might be possible to interpret the entire organism in terms of wave mechanics, the fundamental rhythm of the organism being considered as the curve from birth to death, with the activities of the individual cells within that rhythm being treated as analogous to the "eigenfunctions" of wave mechanics. Finally,

[9] Cf. "The Tau Effect—An Example of Psychological Relativity," *Science*, 1930, Vol. 71, pp. 536–537. The quantitative study appears in *Journal of Experimental Psychology*, 1931, Vol. 4, pp. 202–217.

the analogy helps to justify the use of such metaphorical phrases as the "music of consciousness," the "melody" of an instinct, and so on, since "particles" on the undulatory theory of matter appear as interference effects, like "beats" in music, due to the superposition of of *group*waves. Thus, in a roundabout way, we return to our earlier supposition that the brain may be looked upon as a harmonic analyzer and synthesizer, with the melody and harmony of conscious life interpreted in terms of the consonance of the "fundamentals" and the "overtones" of the wave system of the brain-as-a-whole.

VI. Dimensionality and Emergence

In bringing Part II to a conclusion, let us glance ahead to see how our suggestions about emergence and dimensionality will reappear. Later on (especially in Chapter XX) it will be made clear that our concept of a new or emergent dimension is deliberately framed to provide a reconciliation of the *relativity* of motion and the *absolutivity* of motion. Our view is committed to the theory that although the type of motion in which mechanics is primarily interested is subject to all the principles of Einsteinian relativity, *growth*—a type of change that manifests itself in physics as well as biology—is not relative. It is a form of change to which the general theory of relativity does not apply.

Motion as represented by the four-dimensional space-time continuum is relative; this we must now all admit. But evolution, inorganic as well as organic, must be explained in terms of a historically new dimension of time. To this emergent level of temporal organization the present-day interpretation of physical relativity is inapplicable, even though on the temporally later levels of biological emergence we hold that it is perfectly proper to speak of "biological relativity" and "psychological relativity." This historically new dimension of growth (which, unlike physical relativity, is unidirectional or irreversible) is the $n + 1$ dimension, where "n" is any lower spatial dimension of "materiality" out of which the higher temporal organization of growth emerges. In its broadest sense, however, this process is still "physical."

As an example of such generalized physical emergence consider the case of a water wave. Even though water as a "fluid" is composed of discrete H_2O molecules, we apply a mathematics of continuous quantities (the differential equations of hydrodynamics) to the medium. The wave we see moving over the surface

of the water is composed of molecules that move in but one direction (up and down), and yet the crest of the wave moves forward in a new dimension (horizontally). Similarly in other cases of emergence. We suppose that each rhythm represents the averaging effect of a statistical ensemble, because the field forces (in this case molecular fields) are integrated to produce a macroscopic rhythm.

In Part III we shall develop still further the notion that human consciousness is a new dimension, an emergent from cortical bioelectrical processes. Consciousness thus appears as a new dimension. Since it lies outside the three-dimensional space of the physical continuum, it would be a mistake to try to force its properties and behavior, which occur in many dimensions, into a smaller number of dimensions. If consciousness is indeed such an emergent ($n + 1$) dimension, we may have an explanation of why it can be *experienced* subjectively even though it cannot be *observed* objectively in the three-dimensional space of classical physical science or the four-dimensional manifold of current relativity theory. On the human social level, as we shall see later, this process culminates in the production of a whole with non-summative properties, the wholeness then being associated with a public (or transposable) time which binds the "local" times of the parts into a dynamic synthesis.

By way of further anticipation of what we shall have to say in Part III, let us here merely indicate that on our theory we hold that the local time of each human individual is now, through a process of "mutual aggregation," beginning to cohere into such a new group-time. Telepathy, clairvoyance, and the like are regarded as faint anticipations of this dynamic unity whereby a new social whole is emerging. Along with the emergence of this "group mind," there will be the emergence of a kind of "social nerve" that will be a means of extra-sensory perception (communication), establishing continuity between individual minds. Within this emergent social organism there can be "simultaneity" of perception (telepathy) as a phase of the dynamical contact between the "local" times of the individual personalities. How this will be interpreted in terms of non-Aristotelian logic is a matter that will then be considered.

With these intimations of things to come, we pass on to the social philosophy contained within the foregoing theory of emergent evolution.

PART III

HUMANISM AND THE SOCIAL ORGANISM

*

CHAPTER SIXTEEN

PHILOSOPHY AND CIVILIZATION

The surest method of extirpating all heresies, and of destroying ing the Kingdom of Antichrist, and of establishing true religion in the hearts of men, is by perfecting a true system of natural philosophy.

—Roger Bacon

In a socially minded world, primarily concerned with political maladjustments and unsolved economic problems, it is not uncommon to hear uncomplimentary remarks about philosophers and their futile metaphysical speculations. Quite frequently one meets with such statements as that of the German positivist who summed up his opinion of the subject in the pronouncement that philosophy is a deliberate misuse of a terminology that was created for that specific purpose. In the same spirit an American Behaviorist declared that a philosopher is a person who has been unfortunate in his reading. Perhaps this epitome of the subject was framed when a philosopher quoted to the psychologist the definition of psychology as the "subject in which you talk about things which everyone knows about in terms which no one understands." Whatever the motives behind this attitude, the fact remains that philosophers are all too frequently regarded as creatures who are in some way peculiar, abnormal, and superfluous.

But however wide the deviation of these biological "sports" from the ordinary run of mortals, philosophers still preserve many of the common hereditary traits of the human race. Among other things, philosophers, like all normal human beings, like to believe that their presence in this world is indispensable; they all are convinced that their ideas and good works are of momentous importance. They cheerfully welcome the dictum of G. K. Chesterton that the most important thing about a man is his philosophy. In accordance with this principle, philosophers employ as the test of the fertility of any culture the extent to which their own profession flourishes. A good society, they

believe, is one in which reason is at home. With Mr. Chesterton they affirm that philosophy is simply thought which is thought out. They hold that it is better to have our practices rest on reflective thought than on blind obedience to tradition and authority. Hence they feel certain that philosophy has no small contribution to make to civilization.

Philosophers are agreed that philosophy is highly important; but unfortunately they are agreed about little else. Indeed, one of the first things that strikes the attention of the beginner in philosophy is the lack of agreement among philosophers. One is soon bewildered by the manifold contradictions among opposing theories. In such a situation one soon begins to suspect that the very instrument of reason which philosophers exalt has failed its own advocates. William James defined philosophy as an unusually obstinate attempt to think clearly. It sometimes seems as if the obstinacy of philosophers is more in evidence than their clarity. The perversity of philosophers seems to be manifested in such a situation as this: Recognizing, as we have just seen, that there is some intimate connection between philosophy and civilization, philosophers will immediately disagree as to just what this connection is. The contenders to the dispute usually put the resulting antithesis in this way: Does philosophy create civilization or does civilization create philosophy? And then the fight is on!

At first sight this may seem to be a purely academic dispute that should thrive only in the cloistered atmosphere of a classroom. But that this is not the case may readily be shown. A definite answer to this question would eventually concern the world at large. A final solution to the problem may be of great significance, for on it hinges the answer to the question of whether man masters things and machines, or whether things are in the saddle and ride mankind, as Emerson feared. Perhaps we can make progress toward clarifying and confirming this view by defining what we here understand by the term philosophy.

We are here concerned with what is termed the philosophy of an individual or a people. What is philosophy when it is thus related to persons? We hold that whenever an individual becomes conscious of what he is trying to do, he has a philosophy. Whenever a society knows what its plans are, and consciously approves the purposes or ends which it thus sets for itself, that society has a

philosophy. It may be that this approval is at a relatively low level of reflection That is to say, in the case of the individual, while desire or emotion may be the driving impulse behind the conscious pursuit of certain ends, some of our desires admittedly have little critical thought behind them. Hence very little philosophy is expressed by such actions. Nevertheless, whether the action is instinctive or habitual and of a low order of response so far as conscious control is concerned, or whether it is of the highest level of intelligence, in either case what we do proclaims what kind of person we are, and therefore necessarily expresses some kind of philosophy. In the same way a primitive cultural group, the behavior of which is almost entirely in accordance with the folkways, expresses a more or less inarticulate philosophy. Primitive groups probably do not apprehend clearly what their philosophy is; but for that matter neither do we today understand exactly what we are trying to do and why we consider it worth doing. After all, the difference between primitive society and our supposedly enlightened civilization is a matter of degree; and in thinking out our social philosophies we have by no means completely freed ourselves from the cultural heritage of primitive man.

If it is true that our philosophies are the systems of reasons we formulate to rationalize individual conduct and social behavior, it becomes obvious immediately that the most important thing about individuals or nations is the kind of philosophy they have. The truth of this might be illustrated in various contexts, but here we need only point out that from the present point of view *education is simply philosophy in action.* The educative process is the means whereby one generation passes on to the next those ideals, and the technique for achieving those ideals, that the group agrees upon as being worthy and desirable. Education, therefore, is applied philosophy, and its purpose is to make it possible for succeeding generations to realize more fully the ideals and modes of living which that society has developed. Of course, in the processes of history these patterns of belief and behavior will be altered according to the character of the evolutionary process; but these changing cultural patterns constitute the crystallized forms preserved in the history of philosophy.

If this is correct, it follows that as society advances, philosophy does not grow less important, as some would have us believe, but more important. The validity of this conclusion may be more

firmly established by noting certain parallels that exist between a society and an organism. Philosophy, like the mind of which it is a product, is simply the integration of experiences and responses. Philosophy aims at the resolution of conflicts through some unitary plan or synthesis. Just as in the organism the degree of consciousness is correlated with the degree of complexity of structure (the simpler organisms presumably being less conscious because the problem of co-ordination is more easily solved, while the more complex organisms are more conscious because of the increasing opportunity for conflicts between special desires and segmental responses), so as society becomes more complex there is greater need for planned integration and co-ordination. If the actions characteristic of the potentially conflicting groups within a complex society are not to render unity of action altogether impossible, a social philosophy must be evolved. Just as under the influence of strychnine poisoning, which upsets nervous integration and motor co-ordination, an animal may throw what amounts to an epileptic fit, so in an analogous way society may throw an epileptic fit if harmony of group interests is not achieved in some degree.

It appears, therefore, that as society gets more complicated there is an increasing need for conscious consideration of common plans of action concerning those universal ends that must be realized by all. You can no more have a healthy society with sick social groups than you can have a healthy organism with some unhealthy organs in it. In this sense society may be regarded as a super-organism. It may be—as we shall suggest later—that the reason society is functioning on a relatively low level of response is that it has not yet developed the organ for society which can do a work comparable to what the central nervous system does for individual organisms. At any rate it seems clear that today we need badly a social philosophy which will provide us with concerted plans giving unity and direction to the social process.

The statement that we need a new intellectual synthesis, if society is to secure the kind of harmony of response appropriate to an organism, is not the utterance of a prophet crying in the wilderness. It is the refrain of a chorus of voices steadily growing in strength. Everyone admits that the system of thought called Scholasticism, which gave meaning to the life and thought of the Middle Ages, has broken down. As we have asserted in Chapter

I, medievalism cannot serve the present age. And yet a synthesis, adapted to the needs and conditions of the modern world, is just what is required. As one writer points out:[1]

The social culture of the later Middle Ages (in the twelfth and thirteenth centuries) had an organized and unified character, such as our Western culture has never since seen. As Henry Adams put it, since the fourteenth century European civilization has moved, with increasing momentum, from unity to multiplicity, from harmony to confusion. And it was not the unity of monotony. It was a rich and variegated culture in which all the elements were organized into a vast synthesis. The Gothic cathedrals, the poetry of Dante, the philosophy of Thomas Aquinas, the structure of the social and economic life, no less than the church system, were all harmonious constituents of this great cultural synthesis.

The need for this new cultural synthesis is recognized by our intellectual leaders. No age has sought so earnestly for unifying principles, unless it be classic Greece. No age—not excepting that of classic Greece—has so concerned itself with what we might term the riddle of history. The very recognition of the existence of such a problem is a phase of our felt need for social purpose and guidance. The modern mind is interested in finding an answer to a very specific question: What is the real significance of social processes? Is there any meaning to history? Or is social evolution purposeless?

We have compared the ancient Greeks to the moderns. From some angles the Greeks are unable to throw much light upon contemporary problems. Thus, while the Greeks supposed that their own forms of political organization had been preceded by earlier types, they did not possess the modern notion of social evolution. Hence the problem of progress—what it is, what the criteria of social progress are, and so on—did not exist for them. In the solution of this, one of our most pressing theoretical problems, the Greeks of the golden age of Pericles are unable to give us help. But in other respects the Greeks are in an excellent position to give guidance to contemporary civilization. Probably no one will deny that the Greek city-state is an exemplary model in certain respects. The tremendous specialization of modern life into economic, legal, religious, political, and other activities was

[1] Cf. *The Individual and the Social Order*, by J. A. Leighton, p. 27.

unknown to the Greeks. Hence it was possible for them to think in terms of the business of the state as a whole. The Greek conception of the state, at its best in the thought of Plato and Aristotle, is that the state, like education in general, is to serve in the making of good citizens.

Aside from the foregoing considerations, there is another occasion that brings to a focus the type of question we have designated as the riddle of history. Anything that brings us into contact with the cultures of other peoples may have the same effect. Persons who are devoid of a historical sense cannot see any need for a "philosophy of history." But those who have observed other societies, and who are conscious of the changing character of political institutions, are almost driven to speculate as to where we are going and what the good of going there may be. When one visits distant lands with contemporaneous but exotic customs and institutions, or when one is ideally placing oneself back in earlier and more primitive cultures by reading books on history or in visiting the ruins of bygone civilizations—in either case thoughts arise concerning the meaning of history, thoughts that otherwise would never see the light of consciousness. Those who have read the once-popular book of Volney called *The Ruins of Empires* will recall how this question arises out of the observation concerning the wavelike character of civilization. One nation arises from youth and obscurity to a ripe and fertile maturity, only to sink into the oblivion of old age, replaced by some younger rival which then, in turn, suffers a similar fate.

This aspect of history has been well stated by Sir Humphrey Davy in his little book on *Consolations in Travel*. To bring out the idea the following lines are quoted:

> When I was left alone, I seated myself in the moonshine, on one of the steps leading to the seats supposed to have been occupied by the patricians in the Colosseum [of Rome] at the time of the public games. The train of ideas in which I indulged before my friends left me continued to flow with a vividness and force increased by the stillness and the solitude of the scene; and the full moon has always had a peculiar effect on these moods of feeling in my mind, giving them a wildness and a kind of indefinite sensation, such as I suppose belong at times to the true poetical temperament. It must be so, I thought to myself;—no new city will rise again out of the double ruin of this;—no new empire will be founded

upon these colossal remains of that of the old Romans. The world, like the individual, flourishes in youth, rises to strength in manhood, falls into decay in age; and the ruins of an empire are like the decrepit frame of an individual, except that they have some tints of beauty which nature bestows upon them. The sun of civilization arose in the East, advanced towards the West, and now is at its meridian;—in a few centuries more it will probably be sinking below the horizon even in the new world, and there will be left darkness only where there is a bright light, deserts of sand where there are populous cities, and stagnant morasses where the green meadow or the bright cornfield once appeared.

One of the discouraging notes in those interpretations of history in which pessimistic conclusions abound is the apparent discontinuity in the process of cultural evolution. To the philosophic historian there would seem to be no reason for discouragement if, in the rise and fall of civilization, each culture, as it slid down into ignominious extinction, passed on to the people that succeeded it the best elements in the way of learning and the arts which had been achieved. If, therefore, we could indeed ascertain whether there is cultural continuity, whether human knowledge is conserved, increased, and passed on—so that each nation constitutes a wave bearing upon its crest a burden of treasure passed on to it by neighboring cultural waves, in turn to be passed on to subsequent races and ages—the pessimistic conclusions that history usually seems to support would have to be modified.

According to the gloomy historian, the real tragedy of social change is that history teaches us nothing. We do not seem to profit by the stupid mistakes of our ancestors. This is the depressing aspect of cultural change. But can we be sure that culture is not cumulative? May not culture be a living thing, growing like an organism, absorbing its nourishment from various environments which contribute diverse elements? That this is not an impossible conception is seen in the fact that Hegel, with some plausibility, argued that each people or nation makes its distinctive contribution to culture through a kind of ideological thesis, which is then taken up into a higher synthesis, this latter including the antithetical elements of preceding cultures. Thus history becomes the progress of the spirit through time. Hegelianism, to be sure, is no longer in good standing as a philosophy of history, but surely the essential idea of his interpretation of

history is not radically different from the view of those who hold to the doctrine of the *diffusion of culture*, presented in a vigorous if not persuasive form by G. Elliot Smith and others.

Whether this doctrine, as applied to the past, be true or not, there are good reasons for believing that it is possible for us living today to make the doctrine true for contemporary culture. For what is the significance of all this activity in the social sciences, in ethnology, in anthropology, in what we may broadly term cultural paleontology, if we do not concede that as we progressively rediscover the past we learn something that enables us more adequately to understand the present? We cannot at present demonstrate the truth of the supposition that the ancient Hebrews derived some of their myths and mores from the old Babylonians, Persians, and Egyptians; we cannot now determine the extent to which the Greeks may have borrowed some of their ideas from the Egyptians; and no one has yet proved beyond all doubt that Plato and Pythagoras imbibed their wisdom from the cup of Hindu philosophy. But we do know that the Romans conquered the Greeks, that in turn the victors became the vanquished, and that in this way Greek science and philosophy eventually molded the entire culture of the Occident No one can deny that the culture of the nations of western Europe, and by derivation the civilization of the United States, are the fruits which grew from the tree whose roots were in the soil of the Greece of old Homer. The seed of this tree of knowledge was planted by Thales, the first of the Greek philosopher-scientists; and in short order, among the contemporaries of Pericles, an unparalleled fruitage appeared. In another season, in the land of the Caesars, the tree again bore its harvest. A long winter of sleep followed the fall of Rome, but the tree of knowledge is tough, even though its fruits be occasionally unripe and bitter. So that even today, if we are so minded, we may pick the choicest fruits.

Cultural continuity, therefore, is to some extent a reality, and is becoming more factual as time passes. And this is to be regarded as a desirable consummation. The way in which a knowledge of our cultural heritage helps us to understand the world about us is illustrated by the following lines by Bertrand Russell:[2]

[2] Quoted from "The New Philosophy of America," *Fortnightly Review*, May, 1928.

Western civilization is derived from three sources—the Bible, the Greeks and machinery. The reconciliation between the Bible and Greeks was a slow business achieved in the course of centuries by the Catholic Church. The Renaissance and the Reformation undid the synthesis and left the two elements at war, as in antiquity. On the whole, Protestantism represented the Bible and free thought represented the Greeks. But pre-industrial America was Biblical rather than Hellenic. For reasons which I have not space to set forth the Judaic and Protestant outlook has been found easier to adapt to modern industrialism than the outlook of either Catholicism or free thought.

In America transplantation gradually weakened even those elements of medieval culture which the pilgrim Fathers had been most anxious to preserve. The new outlook appropriate to machinery was thus enabled to become more completely dominant than in the Old World. Whether we like this new outlook or not is a question of little importance. What is important is that the new outlook is increasingly displacing the old, not only in Europe and America but also in the greater part of Asia. In formulating this new outlook and in creating a community living in accordance with it, America takes the lead.

The dominating belief of what we may call the industrial philosophy is the belief that man is master of his fate, and need not submit tamely to the evils which the niggardliness of inanimate nature or the follies of human nature have hitherto inflicted.

One might raise the question of whether Mr. Russell does not make a slip when he states that whether we like the new outlook appropriate to machinery is a question of little importance. He means by this, presumably, that it is here to stay, and that we may as well accept it as an unalterable fact. But of course, if we are to some extent the masters of our cultural fate, if we can in a measure control the direction of human evolution by reflective guidance—a doctrine accepted even by the followers of the "economic interpretation of history"—then we need not accept a condition as unalterable if we do not like that condition.

By the same logic it follows that when we say cultural continuity is becoming a fact we do not presuppose that it is a necessary and an irrevocable fact. And we may also infer that if it is becoming more factual, as we have asserted, this must be because we regard the establishing of a sense of cultural continuity as something devoutly to be sought. The pioneers of our intellec-

tual evolution seem to be agreed about this. The desirability of cultural continuity can be demonstrated by again appealing to the organismic theory of society.

In organisms it is the consciousness of the past, the time-spanning continuity of meaning through memory, that gives direction to present responses. It is no biological accident that those animals which have the greatest powers of memory are also the most intelligent. And the same is true for social organisms. Intelligence, individual or social, consists in using the knowledge and experience gained in the past and preserved in memory in the adjustment to present problems and novel situations. The only nation that has deliberately tried to break with the past and annihilate historical continuity is Russia. But it is interesting to note that Russia has not been entirely successful in this effort. In the attempt to crush religion and eliminate all vestiges of capitalism, the Bolshevists have thus far not been altogether successful. Moreover, we may also note that Sovietism as a political doctrine is related to the socialism of Karl Marx, which, as students of the philosophy of dialectical materialism recognize, was really an offshoot of Hegelianism. That is, the economic determinism of the materialistic interpretation of history is only an inversion of the idealistic determinism of Hegel, and the doctrine of class conflict is the reflection of the Hegelian dialectic of history. So that neither in practice nor in theory has the new Russia broken entirely from the past. We may therefore sum up the foregoing conclusions by saying we must all agree that history has *something* to teach us: how much or how little it will be allowed to teach us will depend in part on how conservative or how radical we are. There is no doubt that too much respect for tradition can be just as harmful as too little. But where the happy medium lies is difficult to say.

Just how a historical perspective may be useful in the building up of the new intellectual synthesis which must be the distinctive achievement of the modern world, is a matter that is occupying the thoughtful attention of our social theorists. Such a synthesis will require time and the co-operation of many minds. It is possible that we may never attain it. It is possible that civilization, such as it is, will perish from lack of co-operation, from frustration of efforts through conflicts of responses having their origins in specialized overgrowths, or cultural tumors. We must all

admit that the dismal picture painted by Oswald Spengler in his monumental work, *The Decline of the West*, is not the morbid vision of a deranged mind. But neither does it represent the necessary fatality of an inescapable social nemesis. The modern world need not go down to extinction.

In the following chapters of Part III we present our own analysis of the problems of modern civilization. We then set forth our own ideas about remedies. Our fundamental thesis is that the troubles of contemporary society are not merely social, economic, and political in character. They are fundamentally spiritual or philosophical. The failure of modern culture is the failure of philosophy; and by the same token the cure lies in the formulation of some new intellectual synthesis. The time is ripe for a new philosophy.

Let us now see what some of the possibilities are.

CHAPTER SEVENTEEN

SCIENTIFIC HUMANISM AND THE CRISIS IN CIVILIZATION

Looked at in its larger features, humanism has definite connections with any philosophic theory about the place of man in nature. Up to the present, interest has chiefly centered in nature as the scene from which humanity has emerged, and man's relation to nature has been mainly that of a student of it, and his place in it as produced by natural causes. The tendency of humanism is to reverse the perspective: to consider how humanity, having once emerged, may and will modify the course which nature will take in the future.

—JOHN DEWEY

I. THE NEED FOR A NEW ORIENTATION

We of the twentieth century are bewildered creatures living in a confused world. Whether we look to the social situation or direct our attention to the domains of science and philosophy, we find paradoxes, incoherence, and chaos. And yet we refuse to be dismayed. Fortified by the last saving gift of Pandora—Hope—and unmindful of the injunction to beware of Greeks bearing gifts, we console ourselves with the reflection that we will somehow "muddle through." We pin our faith to "new deals" that treat the symptoms, hesitating to probe deeper, fearing that a more searching analysis may reveal the need for a more radical procedure. To be sure, the idea that modern civilization faces a critical illness, of which wars and depressions are but spasmodic and superficial symptoms, does lurk in the background of our consciousness. Up to the present, however, the censor has pushed the idea back into the hinterlands of our thought. But the idea will not down, and with the passage of time it becomes increasingly evident that if civilization is to survive we must turn our backs upon wishful thinking, look the facts in the face, and deal with realities as they are.

In a measure we are all aware of the dangers that threaten modern civilization: war-breeding nationalism, racial hatreds, religious fanaticism, political corruption, and the like. The Marxian socialists have preached about the inherent contradictions and cleavages growing within the capitalistic state. We have seen the decadence of institutional religion as an instrument of moral guidance and social control. We realize that the modern industrial world is a mushroom growth based upon subsidized research, and we have discovered that the material benefits of this alliance are gobbled up to satisfy the insatiable appetites of profit-seeking entrepreneurs and greedy stockholders. We witness science, with the passage of time, increasing its power over nature at an ever-accelerating rate, while its growth in understanding and humanitarian social control appears to lag woefully behind.

If the results of applied science are prostituted on the markets of commerce, the results of pure science yield Frankenstein monsters of fact that plague their discoverers. While cosmologists ponder the mysteries of cosmic rays, mathematicians stand befuddled before the paradoxes of an "infinite"—which they cannot do without. In the meantime, not to be outdone, geologists and astronomers play celestial ping-pong with the time concept, debating whether the cosmos can be younger than the stars of which it is composed. In the third ring of the scientific circus the psychologists entertain the audience with riddles: "When is a Behaviorist not a Behaviorist? When he is conscious"! To complete the tragicomedy it needs only the last detail—educational practitioners dedicated either to the reiteration of archaic formulas, or blindly groping toward an unseen light—in either case an unimpressive performance in the face of unparalleled opportunity.

For the moment all this adds to the gaiety of nations and would distress no one, were it not for the deep and troublesome suspicion that it is fiddling while Rome burns. And there's the rub! People love and want their Rome, while yet it burns. The adventure of civilization is too high and zestful to allow it to come to so ignoble an end, at least so early in the play. Humanity did not emerge from the long struggle of pre-human evolution to live only a fitful day upon our planet. We need the remaining acts of the drama to find out what it's all about. One can't understand a play without knowing the denouement—if any—and to discover

that requires that we linger a little longer. Whatever Freud may say about the "death wish," and however strategic may be our position for committing social suicide, the will to live is hardly less potent in us that in Neanderthal man. Hence our dilemma. And what is the way out? The answer to this question depends upon one's analysis of the causes of our trouble.

The causes of the imminent collapse of our culture are not universally agreed upon. But this, of course, is only another manifestation of the cultural chaos that besets the modern world. Some attribute our troubles to the failure of the capitalistic system to overcome those inherent disruptive tendencies of the economic order we have already mentioned. Others ascribe the conflict and confusion of the modern world to the political situation—the excessive nationalism of imperialistic states. Still others argue that it is because the modern world is irreligious, has "forgotten God," that we are headed for disaster. And so the various diagnoses go on.

If our own theory that the troubles of the modern world are a result of the failure of philosophy is true, and if it is also true that changes in practice cannot be consummated unless and until there are equally profound changes in theory, then it becomes evident that a fundamental revision of our philosophy is called for. But how shall such a new scientific world view, a vision that will provide an emotional outlet for mankind guided by intelligence, be attained? What new philosophical synthesis, or world religion based on science, can again inspire men in this despairing age? In the present volume we are trying to picture such a vision, so that you may then judge whether it may unite humanity and persuade men to look forward with a greater measure of hope toward a fearful and uncertain future. As we have already noted, this broad undertaking involves a twofold task: first, *to demonstrate that a radically new mode of human thought and orientation will be operative in the future, or must become so if mankind is to survive*, and second, *to indicate in broad outlines what the world will appear to be like when it is understood in terms of these new principles*.

Our thesis, then, is this. If the modern world is to survive and continue its progress into a problematical future, its established culture-patterns, or models of belief and action, will have to be replaced by a new mode of orientation, a new culture-pattern. Viewed in this light, the disintegration of our contemporary

civilization is only the inevitable concomitant of, and necessary prelude to, the fabrication of a new world culture. If we are to escape the impending disaster that hangs over our present precarious world, we must make our revision of the old patterns so far-reaching and so fundamental that our very modes of thinking about ourselves and our relations to each other and to the world at large will be overhauled.

II. The Evolution of Humanism

We have said that the new philosophy for the new civilization is humanism. But "humanism" is a term of several meanings. Fortunately the situation is not so bad that, as with Christianity, one may say of it that it is all things to all men. Our previous description of this philosophy may now be condensed into the following definition: "Humanism is the doctrine that men, through the use of intelligence, directing the institutions of democratic government, can create for themselves, without aid from 'supernatural powers,' a rational civilization in which each person enjoys economic security and finds cultural outlets for whatever normal human capacities and creative energies he possesses." This definition of the term[1] is quite in keeping with the historical use, as a brief consideration of the matter will show.

Literally the term "humanism" comes from the Latin *humanus*, "human," and is connected with *homo*, "mankind." "Humanism" as a label was first applied to the literary movement in Europe in the fourteenth and fifteenth centuries, at the close of the Middle Ages. This movement was a part of the more general cultural revival known as the Renaissance. The "humanists," who are responsible for the revival of interest in the learning of classical antiquity—of Greek and Roman civilization—first appeared in Italy. It will be recalled that "paganism" had never been fully stamped out in Italy, and at the beginning of modern times this interest in classical paganism burst forth again in such men as Petrarch, who has been called the first of the moderns.

Unfortunately the same thing happened to this earliest form of humanism that happens to almost all novel and vital developments: it soon solidified into a set of dead formulas and fixed orthodoxies. The original humanists were interested in the Latin and

[1] From the writer's *Philosophy and the Concepts of Modern Science*, p. 311.

Greek languages because they needed them for an understanding of the cultures of these ancient civilizations. But the seemingly inevitable happened again. In a short time that which originally had been a means to an end became an end in itself; educational idolatry set in, and in the classical cultural theory of education we have the apotheosis of the "humanities" as things in themselves. The ideal of the educated gentleman then becomes that of an individual who has studied Latin, Greek, and mathematics. These subjects thus constituted the backbone of the educational systems of early modern European and American colleges and universities. When we recall that it was this same classical cultural system, or *classicism* as the worship of the *humanities*, that made it almost impossible for the newly developing sciences to find their ways into the curricula of our universities, we see the extent to which humanism, originally expressive of an interest in man and society and nature, had fossilized into a fixed creed. The most recent manifestations of the humanism of the classical cultural tradition are to be found in the literary humanism of Irving Babbitt and Paul Elmer More and the neo-Scholasticism of Jacques Maritain. Babbitt's view is a protest against the emotional excesses of romanticism; it stresses the need for respecting the classical forms in art and literature, and has much to say about the "inner check" that reason should exercise over our impulses. At its worst, literary humanism represents a kind of intellectual snobbery and as such richly deserves the castigations of Henry L. Mencken, whose sardonic assaults upon professorial balderdash have been aimed for the most part at Irving Babbitt.

The next variety of humanism to appear was introduced by Auguste Comte, the French philosopher and reputed founder of the science of sociology. Comte put forth a "religion of humanity" similar in nature to that of Thomas Paine, except that it is worked out in more detail. This form of humanism was promulgated by several of the early advocates of pragmatism, especially William James and F. C. S. Schiller. John Dewey has also flirted with this view—if Dewey may be said to "flirt" with anything.

It is with this brand of humanism that the view I am here presenting has most in common. Pragmatism is as indigenous to America as anything we have produced, even though William James did say of it that it was but a new name for old ways of thinking. Pragmatism has come in for much discussion, and

obviously not everything that pragmatism (James) and instrumentalism (Dewey) have advocated can stand up under hostile criticism. It seems to me that the most significant idea which contemporary humanism takes over from earlier pragmatism is the notion that the world is still incomplete, still in the making, and that man is a real agent in determining the character and direction of developments yet to come. As thus stated, this may not sound impressive, but if one contrasts the consequences of this view with the implications of certain religious and scientific doctrines, the full force of the humanistic movement begins to appear.

Before leaving this historical sketch of the origin and variations of humanism, let us emphasize that the present meaning of the term, as embodied in our own previous definition, is still within the philosophical framework of humanism as we have described it in its earliest (Renaissance) form. Nevertheless the doctrine is on its way, and today is no longer completely identical with its Renaissance progenitor. Such social interpreters as C. Hartley Grattan, E. T. Bell, and others have assumed that all humanism is "literary" and therefore unscientific, but when these otherwise enlightened critics learn that naturalistic humanism, or the scientific humanism of Lancelot Hogben, George Sarton, Thomas Mann, Max Otto, E. A. Burtt, and others, has already supplanted literary and scholastic varieties, they will discover that many of their comments and criticisms are pointless.

III. Some Theses of the New Humanism[2]

Explicitly stated, and as I see it, the more important theses of the new humanism now stand as follows:

(1) In any given era (or "cosmic epoch," as Whitehead terms it) the operations of the physical world are something we must take as given, and man must function within this framework of a relatively stable and fixed physical order of events.

(2) But since "scientific laws" are provisional statements and useful only so long as they adequately describe natural processes, we human beings should not be bound too rigidly by traditional notions of what is "possible."

(3) Since every event is multi-causational, we should realize that all human statements ("laws") are a product of intellectual

[2] In developing these theses I am indebted to Mr. Lloyd Morain and the Los Angeles group of Scientific Humanists for suggestions. This is the first group of its sort in the world.

abstraction, and accordingly all explanations and causal analyses are relative to the purposes of the investigator. Even the fundamental and time-honored "laws of thought" are a function of the stage in social evolution at which the thinker operates.

(4) Our intellectual abstractions, and the linguistic equivalents that express their meanings in communications, should always be subject to semantic analysis, so that human understanding and discourse are facilitated. Our difficulties and misunderstandings frequently have a verbalistic basis.

(5) Man is a real agent in determining the future course of events in nature and society. The future of our earth—perhaps the cosmos—cannot be foreseen without taking into account the role that humanity is to play in this as yet incomplete drama.

(6) "Human nature" is characterized by wide plasticity, and this provides a flexible basis for social advance.

(7) Scientific control of the world has reached a stage where our society can readily produce food, shelter, and clothing (economic security) for all. Philosophical cynicism, defeatism, and escapism arise from an inadequate understanding and ability to cope with our social problems. Our present problems and difficulties are surmountable, but the broader background of social causation is world-wide in scope, and no simple panacea will cure all our ills.

(8) In order to make peace and security possible, fundamental changes in our political and economic systems are necessary. A United States of the World, implemented with police power to enforce common decisions, is the ultimate goal of social advance. Global planning (or "global thinking" applied to economic-political problems) is the next step in the utilization of our social intelligence.

(9) It is desirable that all groups working for the improvement of the world develop means to co-operate. In order that the benefits of social co-operation may be hastened and serve universal humanity, it is essential that knowledge be made available to all. Science as well as politics, religion, and economics must be socialized, universalized, and humanized.

Now let us indicate some of the implications that flow from these theses of the new humanism.

The view that the world is still incomplete, and that what is to be man himself will help to determine, frees us from the philosophical nightmare of those twin fates, the theological absolute (God)

and the scientific absolute of Laplacian mechanism. An ancient theorizer once raised the question of whether man, by taking thought, could increase his stature by one cubit. So far as we now know, the answer is in the negative. It is probably true, as noted in our first thesis, that the validity of certain accepted propositions is quite independent of our hopes, wishes, and fears. This, I suppose, was what William James meant when, in his later life, he confessed that *reality isn't so damned plastic after all!* Nevertheless, in psychology and the social sciences we do find situations in which the "truth" or "falsity" of beliefs is related to our beliefs about those same propositions. That is, in some cases certain beliefs are made "true" by the fact that they are believed to be true. Thus James pointed out that there may be a pragmatic sanction for believing in freedom of choice (will), if the belief in such freedom actually leads a man to hold himself "responsible" for what he does. In some cases it does make a difference what we think. An instance of this point can be selected from the field of social theory. Thus T. V. Smith once pointed out that socially *a man is what he functions as*, and this suggests that in so far as men act *as if* they are equal, to that extent they are, or tend to become, equal socially. Psychologically it is probably false that all men are created (born) equal, but if we treat men as equals in terms of certain civil rights, then the proposition that men are equal (in a legal context) is made true by virtue of the fact that it is accepted as true.

Now bring these ideas to a focus on the current problem of economic readjustments. If our theses are pragmatically validated ("true"), man's behavior in society is no more controlled by some super-personal "economic" laws than individual human behavior is coerced by some overruling psychological or biological laws. Man *is* those laws—so long as he acts in accordance with them. Man is continually putting himself in chains; he makes the very laws he then bows down to and "obeys." Humanism insists that we do not need to take society and its economic laws as something given, absolute, and immutable through all time.

And now a few words about religion and its place in a humanistic society. It goes without saying that humanism is opposed to orthodox-authoritarian religion. It denies that institutionalized religion has any exclusive right to the use of the term religion, and some humanists, if pressed on the matter of their lack of theistic doctrine, would probably point out to old-line denominationalism

that the term "atheism" was first applied to the early Christians who repudiated the worship of the pagan gods of the Greeks and Romans. Whether humanism chooses to class itself as a religion is therefore optional so far as terminology is concerned. Some writers have used the term *religious humanism;* but the term *scientific humanism* is just as suitable as a name for the set of ideas here presented. Since, for humanism, everything here on earth exists for the sake of man, science, too, must be the servant of humanity; that is, man does not need to conform to an antecedent thing called science. What science "is" depends upon what man chooses to make it. It can become our "religion" if we will it so; and in some future age that which has hitherto been the undisputed province of churches and the clergy may become a proper part of the domain of what we now term science. Of course, in that day science will have been reinterpreted and its scope enlarged. In the following chapters an effort is made to suggest how such a scientific religion may provide the basis for a new type of social science.

Looked at as a whole, humanism appears as the most radical movement in contemporary culture. And yet no man need fear its influence, for it serves no special interests and represents man's efforts to recognize his own dignity. Humanism has but one commandment: "Have faith in man and the potentialities of his intelligence." Of course—following the example of the classicists—it is well to admire the best that man has thought and accomplished. Humanism does not despise or decry the past attainments of the human race. But above all things else let us also remember, as Nietzsche said, *man must be surpassed.* In a certain sense the goal of humanism is super-humanism! Evolution is not yet done with the human organism—or better still, man must take his own fate in his hands and, through scientific understanding, guide his own evolution along lines of progress that he himself must set. If it is true, as a distinguished scientist recently stated, that man's social progress has reached a point where he needs a larger brain to guide him in an increasingly complex world, then man now faces the supreme task of creating or remaking human nature to suit the needs or requirements of our social architects. In the meantime, and until we learn how to take safely the fate of biological evolution into our own hands, let us continue to make the best possible use of such intelligence as we are now endowed with.

CHAPTER EIGHTEEN

SYMBOLIC LOGIC AND SOCIAL SCIENCE

A science which hesitates to forget its founders is lost. To this hesitation I ascribe the barrenness of logic.

—A. N. Whitehead

I. The Salvation of Social Science

The world is ready for a new philosophy. Such a view, arising from a fusion of the emotional and intellectual springs of action, must culminate in a humanized social science. But the new humanism which thus purports to overcome the frustrations of modern life is not a recrudescence of primitivism. The coming synthesis requires for its consummation the finest intellectual attainments, and in its progressive delineations must repeatedly submit itself to the tests of scientific method. The reference to scientific method is not accidental. Ultimately this means that the formal structure of the new humanism must exemplify the principles of symbolic logic. And it is the purpose of the present chapter to show that in symbolic structure we can express the skeletal outline of this humanistic philosophy.

It is not too much to say that the present chaos in social science is due precisely to the failure to take advantage of the discipline whose virtues we are here recommending. This, of course, is an arresting claim. What, indeed, are the merits and potencies of this alleged savior of social science? What is this new pretender, which boasts of the power to make social science what it is not at present—scientific in fact as well as in name? Curiously enough, the social scientist cannot himself answer these questions.

At the present time the equipment of a social scientist usually consists in a knowledge of the main facts of history and social evolution, a smattering of anthropology and psychology, and the ability to handle statistical methods. Such are his attainments and limitations. A knowledge of logic, particularly of the technique of deductive system—which is the substructure of both

mathematics and ordinary logic—is not considered essential. This situation is due in part to the fact that social science, wishing to appear "scientific," has reacted against everything "philosophical," and has therefore refused to profit by anything that philosophy has to offer, so that logic along with "metaphysics" has been declared taboo. The remainder of the explanation of this situation is to be found in the fact that logic, up to the present, has not been prepared to make any important contributions to social science. But of late logic has been making rapid strides, and today is able to present some formulations that have important and interesting applications. These formulations come directly out of what is now termed mathematical or symbolic logic, and before presenting these formulations it is desirable to return to these new developments in modern logic.

First of all, then, let us answer the question, What *is* symbolic logic?

II. The Nature of Symbolic Logic

The term "symbolic logic" is synonymous with the term "mathematical logic." One confusion we must avoid is that of supposing—merely from its name—that symbolic logic is traditional logic (of the Aristotelian type) expressed in some sort of symbolism. Undoubtedly modern symbolic logic is historically an outgrowth of the Aristotelian formulation, but now it has gone far beyond it in many ways. For that matter, the use of an elementary symbolism has always characterized traditional logic, so that the increased use of symbolic devices is not the main feature which differentiates traditional and modern logic. The fact is that the very character of logic has been modified by the increased use of symbolism, so that Aristotelian logic developed into mathematical logic by the very process of applying symbolism to the older forms. Thus what are now called new validating forms of inference have appeared.

It is difficult to exaggerate the benefits of an increased use of an adequate symbolism. The values that result are at least four in number. In the first place, *symbolism is desirable because of the economy of mental effort that it makes possible.* An excellent illustration is found in mathematics. As others[1] have shown, operations

[1] Cf. *Symbolic Logic*, by C. I. Lewis and C. H. Langford, 1932, p. 4.

that any fourth-grade child can accomplish in the modern notation taxed the best minds of the age of Pericles, because the Greeks had no symbol for zero and used the letters of the alphabet for other numbers. A second illustration is given by L. S. Stebbing when she points out[2] that although Newton and Leibniz both invented the differential calculus, Leibniz's notation was much superior to that of Newton, and those who used Newton's symbolism were much hampered by Newton's notation. For this reason, during the next century no important mathematical discovery was made by Englishmen, while on the Continent, where Leibniz's notation was employed, rapid progress was made.

The second value of symbolism is that *it makes possible more complicated forms of reasoning*. Thus modern symbolic logic makes evident the fact that the syllogism, which historically has been stressed almost to the exclusion of all other types of deductive inference, is really only one small hill in a vast mountain range of deductive inference. The study of asyllogistic (or extrasyllogistic) forms of inference, first seriously undertaken by Leibniz, now reveals the fact that the traditional syllogism is but a special instance of a much broader logic of transitive relations.

The third value of symbolism in logic is that *it has brought out the fact that Aristotelian logic has assigned a special and undue importance to the so-called "laws of thought."* The most conservative way to state the recognition of this principle would be to say that modern symbolic logic now holds that the three Aristotelian laws—the "laws" of identity, contradiction, and excluded middle—are no more and no less important than the other principles necessary to validate inferences. Thus, if we really take this seriously, the law of excluded middle would be on a par with the "commutative law," or any other that conventionally appears. The more radical statement of the new outlook would be that modern logic teaches us that *there are no laws of thought*, in the sense that there are laws of physics. If we combine the views expressed by Hilbert, Wittgenstein, and Lewis, we come out with the following thesis: Deductive system (including pure logic and mathematics) is the manipulation of meaningless (though recognizable) symbols, according to arbitrarily selected rules of operation, the inferences deduced being strings of tautologies which

[2] *A Modern Introduction to Logic*, 1930, p. 125.

unravel the logical possibilities wrapped up in any such set of postulates (or rules of operations on symbols).[3] Whether one prefers the more conservative or the more radical statement is a matter for personal decision.

The fourth value of symbolism is that *it reveals form.* The use of a proper symbolism may show (1) that logical forms (relation-structures) which hitherto appeared to be similar are dissimilar, and (2) that forms which appear to be dissimilar are really similar. In connection with (1) we may note that the Aristotelian tradition treats as identical certain forms that modern symbolic logic regards as essentially unlike. Thus in Aristotelian logic the verb "to be" expresses the relation between the subject and the predicate (S is P) of a proposition. This same form was used to cover both the identity-relation ($S = P$; Socrates is the wisest man of Athens) and the relation of class inclusion ($S < P$; all men are vertebrates). These two, and other uses of the verb "to be," are now clearly distinguished, and, as we have seen, Bertrand Russell has had very caustic things to say about their former identification. Aside from this oversimplification, traditional logic was also forced to emasculate compound propositions in order to fit them into the subject-predicate form of expression.

With respect to (2), symbolic logic shows that relation-structures which appear to have nothing in common really possess the same *logical form.* It is a simple fact of experience that if we see certain formal similarities on a printed page, as made evident by the proper symbolism, we can recognize intellectually the underlying equivalence of relation, or meaning, or inference. This is brought out in Table IV, The Logical Structure of Science. Thus the generalization from the propositional functions of Bertrand Russell to the doctrinal functions of C. J. Keyser is possible, or made more obvious, by the formal similarity. Adopting the language of gestalt psychology, we may say that the logical *Gestalt* (form) is an exemplification of the visual *Gestalt* (form) of a pattern of symbols. When we recall that mathematics has

[3] By way of being fair to the present status of the problem, and possibly by way of criticism of the present conception of the nature of deductive system, it needs to be admitted that most logicians and mathematicians still insist upon a separation of "rules" and "postulates." Also, "tautologies" are usually defined in terms of a "truth table" or matrix. But I hold that the present conception is also tenable. We have already been concerned with the tautology theory of logic.

TABLE FOUR

The Logical Structure of Science

Terms 1. .. . 2. .. . 3. .	(1) *Terms* (defined and undefined) are symbols that represent the *concepts* we use in our thinking.
Postulates 1. . 2. . 3. . .	(2) *Postulates* are the rules that tell us what operations are permissible.
Theorems 1. . ... 2. . . 3. .	(3) *Theorems* are the implications deduced from or validated by a set of postulates.

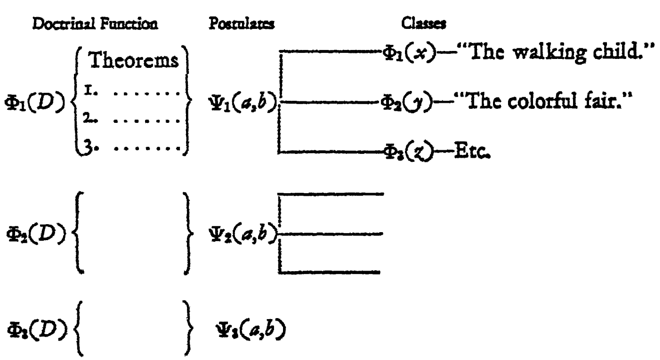
The Nature of Systems

(1) Our base consists of "classes" of things, and a class consists of those individuals that satisfy a *propositional function.* Our *concepts* are thus propositional functions with one variable, $\Phi_1(x)$.

(2) Postulates are propositional functions with two variables—that is, $\Phi(a,b)$—which state the relations between (or operations upon) terms (or concepts). It is on this level that serial order appears. Serial order, like mathematics in general, is based on such logical relations as "is greater than," etc. Relations are classes of couples that behave like classes. Thus the logic of the relations is derived from propositional functions of two or more variables. In the *Principia Mathematica,* mathematics is derived from the logic of relations and thus leans heavily upon propositional functions of two variables.

(3) A doctrinal function consists of all those theorems that are validated by a set of postulates. Thus any *theory* of science is a doctrinal function. It consists of the body of theorems deduced from a given postulate set.

In diagrammatic form this appears as follows:



been defined as the science of form, the importance of this point becomes clear.

This last value brings us to the point where we may make use of the general procedure of deductive system as it is represented in Table IV. It needs to be kept in mind that contemporary natural science cannot be completely cast into the mold of deductive system, simply because induction, experiment, and observation introduce new elements and laws. The form of a perfect science is that of mathematical system, but no science as yet is perfect and complete—not even mathematical physics. Of course, those who subscribe to the doctrine of emergent evolution are necessarily committed to the thesis that no natural science will ever be absolutely perfect.[4]

Now let us examine in turn each stratum of the three levels of our scheme of the structure of science.

III. Logical Positivism and Creative Thought

The first level is the level of classes, and in Table IV (see page 251) this is the column on the bottom right. In symbolic logic a class consists of all the individuals that satisfy a propositional function (x). That is, the class (x) consists of the members possessing the property ϕ. In the abstract a propositional function is neither true nor false. But if we assign values to the variable (x), we have the propositions which, in a *two-valued* logic (see Chapter IV), are either "true" or "false." Thus if we say, "x is the wisest man of Athens," the statement is neither true nor false, but it becomes a proposition when we substitute "Socrates" for x.

In connection with this first level of deductive system, the level of *classes* and *concepts* (or class-concepts), it is convenient to present the philosophical basis of the present scheme against the general background of the current doctrine of logical positivism. This theory, which has attained a considerable following in Europe, especially in the Vienna school, is really a form of philosophical behaviorism stated in terms of mathematical logic. Ludwig Wittgenstein, a former pupil of Bertrand Russell, was one of the

[4] If we think of induction as entering into the system through the framing of definitions and the selection of empirical postulates ("laws of nature"), the above scheme represents the form of both pure deductive system and natural science. The difference comes in the manner of framing definitions: in *natural science* definitions are a result of *inspection* (induction from particulars), whereas in *mathematics* definitions are a result of *postulation*.

original motivating personalities behind neo-positivism, which now includes Rudolph Carnap and others in its list of loyal supporters. The only American constituent of this general movement comes from Charles S. Peirce's test of meaning in terms of verifiable consequences. Bridgman's "operational" theory of concepts comes close to the central tendency of the positivistic *élan*.

At the present time there is a rather general effort to interpret the function of philosophy in terms of the clarification of ideas. The motive behind *philosophy as analysis* is commendable, though of course this is not an entirely new idea. Descartes, for example, also sought a method—a mathematical method—for resolving philosophical differences. The purpose of logical positivism (or logical empiricism) is not only that of the clarification of ideas and issues; it also seeks a criterion for identifying and eliminating those types of problems that give rise to the endless and futile disputes which have infested philosophy ever since the days of its origin in ancient Greece. The attainment of this aim calls for the formulation of a test of meaning: when are problems meaningful and when are they meaningless? The answer, for logical positivism, is that only those kinds of problems are meaningful and sensible the pretended solutions to which can be tested and verified empirically.

According to logical positivism, the first prerequisite to philosophical clarity is to be discovered through an analysis of the nature and function of language. What we need, as Leibniz realized, is a universal language that, like a map, will enable us to find our way about in the world. In order to have a meaning, a proposition must picture the world; to be true, logical analysis must reflect the structure of fact. A true statement, therefore, gives you control over facts, or complexes of facts. A language that will enable us to pass from one moment of experience to another must be so constructed that we can always translate our assertions into expectations of future experiences. Such assertions, if they are to be meaningful, must be convertible into operations in and upon the world of sense data, the world of physics, as Ernst Mach pictured it. Thus it turns out that the universal language is the language of physics, and the entire domain of philosophy reduces to that which is expressible in the mathematical logic of that science. It is for this reason that logical

empiricism is sometimes called "physicalism." The language of mathematical physics provides us with a set of formulas that represents the world as we experience it through our senses, and only those problems and viewpoints have meaning which are translatable into this symbolic representation of sense data. Or in still other terms, on the basis of a study of the syntactical structure of language—as illustrated by the work of Carnap—an idealized language is developed through which we can translate solutions to meaningful problems into predictions, which are expectations of the appearance of future sense data. This rules out as meaningless all statements and questions that are not expressible in the language of empirical operations.

Positivism appears as a radical and disturbing movement to some philosophers because it banishes from court many interests dear to their hearts. On the negative side, the new positivism condemns the following branches of philosophy: (1) metaphysics, because its problems are pseudo-problems, and its answers are meaningless; (2) normative science, because it is self-contradictory—there can be no "science" of values; (3) speculative philosophy, because its theories and conclusions are empirically unverifiable.

Since some of the motivating interests behind the writing of the present volume are among those which are taboo in logical positivism, it is necessary to examine this view and, if possible, discover its defects. Philosophy as a speculative venture and as an instrument of social reconstruction—Dewey's view—may not be *necessary* philosophy, but that it is at least legitimate is a point I shall now attempt to establish.

At the very outset we must note—what the advocates of philosophy as analysis would probably admit—that the analysis of the meanings of ideas and class concepts (our first column) is always in terms of the system we are examining. Terms are entry-points into systems, as L. O. Kattsoff says. Concepts must be understood in their own logical frameworks, or contexts. *Meanings are implications within a system.* Wittgenstein makes this point in a more limited way when he states that only in the context of a proposition has a name a meaning. But now mark this: the entire system is always the result of the creative thought of the originator of the system under consideration. Thus if we undertake an analysis of the meaning of the concept of "force,"

or "space," or "time" in Newtonian mechanics, or the meaning of "surplus value" in Marxian economics, etc., we are analyzing meanings within a system. But it is surely clear that in the original construction of such a system, emotional elements or affective colorings entered in as motivating forces and attitudinal determinants. The idea that a system of philosophy or science should have no "ax to grind" and should be interested solely in cognitive meanings assumes an "elementalistic" theory of human nature which all modern psychology teaches us is false. And to decry the construction of such systems and speculative ventures is in effect to nullify the existence of the very systems that make possible the application of the operational theory of meaning. Indeed, does not such a view condemn a Newton, or a Marx, while he is living, because his thinking is motivated by extra-rational factors and purposes, only to honor him in his death by subjecting his system to analytical scrutiny in its "own terms"? It ought to be self-evident that before there can be "critical analysis of concepts" there must have been a creative synthesis of concepts. How can one pursue philosophical analysis, if there be nothing to analyze?

The philosopher need not confine himself to the clarification of meanings in classical systems of thought; he may, if he wishes, undertake the creation of new systems. The constructive thinker is a social architect. His problem is not merely that of seeing how language is actually used. His problem is also to discover what, in an evolving world, words *ought* to mean in new factual frames of reference. Since the meaning of a concept is to be discovered in the way in which the concept functions in a system, the creation of new concepts calls for new systems, and changes in systems carry with them changes in the meanings of at least some, and possibly all, of the fundamental concepts. For example, the redefinition of the term "justice" in any system of social philosophy —that of Aristotle, John Locke, or John Dewey—implies a redefinition of other related concepts, such as "equality," "rights," and the like. This principle that it is the business of philosophy to tell us what words ought to mean evidently was recognized by Plato. In the *Republic* an effort is made to discover what "justice" is. It turns out that justice is not realized in any existing state, and Plato (or Socrates) creates an entirely new state (utopia) wherein justice, properly defined, might be attained. From all

this it appears that *the concept is not the common denominator of the class; it is not the composite image of the individuals denoted by the term.* At least social and ethical concepts are *creative* rather than *descriptive* in nature. "Liberty," "individualism," "democracy," and the like are dynamic ideals, and one of the problems of social investigation is to find out how (imaginatively) to change the structure of society so that "social engineers" can give a local habitation and a name to concepts and ideals that never were on land or sea. In brief, the problem of philosophy is not only to find out what words and sentences *do* mean, as the believer in philosophical analysis supposes; *the business of philosophy is to use language (words) in ways in which it has never been used before!*

It is significant that this normative element is present even in physical science. One problem—the descriptive one—is to find out, for example, what the concept of "mass" means in classical physics. One may then determine what this idea means in present-day relativity physics. Presumably it is still within the domain of description and clarification of meaning if we next undertake a comparison of the idea of mass in Newtonian and Einsteinian physics. As already noted, such comparison shows that in classical physics "mass" is an absolute quantity, whereas in relativity physics it is not absolute, since mass becomes a function of velocity. At this point, therefore, we see that an analysis of "mass" introduces the concepts of space and time. Further investigation reveals that the modern physicist has an entirely new quiver of concepts. Such notions as the "space-time continuum," the "probability wave," etc., are what one physicist termed "foxy concepts." But how shall these new ideas be adjusted to each other? In other words, what *ought* the terms "determinism," "probability," "time," and the like mean in their new logical frameworks? And is it not clear by this time that the difference between the *logical* "ought" (intellectual compulsion) and the *normative* "ought" (ethical compulsion) has reached the vanishing point? If so, the operational theory of meaning itself justifies us in concluding that the two are indistinguishable, since for logical positivism the Peirce-Wittgenstein principle, that an unverifiable difference is no difference, is the only criterion to employ.

The burden of the foregoing argument may be summed up in this manner: class concepts represent the first level in the hierarchy

of deductive system. But the number and character of the elementary constituents of any system of thought are determined by what you must get out of that system. In natural science there is no logical atomism of such a sort that units are combined mechanically on the first level to produce complex systems. The parts, which are classes of facts, are differentiated out of a whole, and the "whole" in any system is the entire domain of phenomena to be comprehended. Even in logic and mathematics there is an "interaction" between the theorems to be deduced and the concepts selected to prove the theorems. How the body of phenomena of any particular natural science came to be delimited in its present precise form is usually a long and complicated story. But scientists now do assume the *relative* independence of different domains of facts. Within any given field this differentiation out of the constituent elements is conditioned by the entire gestalt. The following quotation from R. M. Eaton[5] brings this out: "The logical test of a good definition is not, then, its clarity to the mind, but its ability to give us what we want in our conclusions." *An atomistic logic is just as inadequate as an atomistic psychology or an atomistic sociology.*

IV. Some Applications of Logical Structure

So much by way of discussion of the first level of logical system. On the second level we are concerned with the postulates that state what operations are permissible in any system. In mathematics and logic, the rules governing the manipulation of symbols (or interrelation of terms) are arbitrary. Thus in geometry, for example, whether one chooses to develop the implications of the postulates of Euclidian geometry or of non-Euclidian geometry, is entirely a matter of taste or preference. In the algebra of logic, a system that is non-commutative is just as "good" as the traditional system, which is commutative, and it may be just as valuable practically in some branch of science. Logically the main element of coercion in the selection of postulates lies in the condition that once a person has chosen a postulate, the others added to the system must be *consistent* with, and *independent* of, the prior postulates, and all of them together must be necessary and sufficient to validate the system of implications to be comprehended

[5] *General Logic*, 1931, p. 298.

in that domain.[6] But only in a purely non-empirical science is this degree of freedom possible. In any natural science the postulates must be statements of the ways in which things invariably behave in that domain. These fundamental assumptions must be so chosen as to enable the scientist to deduce from them all the complex phenomena of his selected field. Any such systematic organization of elementary concepts, laws of behavior, and derived theorems constitutes a *theory* of science.

From the present point of view, any theory of science is a doctrinal function, a higher organization of propositional functions. According to C. J. Keyser, a doctrinal function consists of the propositional functions, the postulates, and the theorems deduced from these. A study of doctrinal functions in the abstract brings out certain features that are important. Several of these are:

(1) The implications of a system may be studied without reference to the question of the material truth or falsity of the postulates.

(2) If two deductive systems have the same structure, they are isomorphic—they have the same logical properties. Thus two doctrinal functions are isomorphic if there is a one-to-one correlation between their postulates and the derived theorems.

(3) An abstract postulate set may be capable of a number of interpretations. To take an example from the field of natural science: if one starts with the assumption that the mental and the physical, the subjective and the objective, are two different ways of viewing and describing the same set of biological facts, then psychology and physiology are two concrete interpretations of the same postulate set. It might be possible to show that if psychoanalysis and Behaviorism start from the same biological postulates, they are merely two different languages, or isomorphic structures, describing the same set of phenomena from two different points of view. Since, however, they *do not* lead to the same set of consequences (deduced theorems), we have reason to believe that this may be due to some difference in fundamental assumptions.

We have used the term "isomorphism." One of the most important types of isomorphic structure we discover in nature is based upon what is technically known as the postulates of serial

[6] In the writer's book *Humanistic Logic*, pp. 190 ff., it is explained why "consistency" is a much more intricate matter than is commonly supposed.

order. Serial order is illustrated by the series of natural integers. One very important property of serial order is that of "transitivity." Thus if *A* is "larger than," or "to the left of," or "precedes," *B*, and *B* bears that same selected relation to *C*, then *A* bears that same relation to *C*. The vast majority of the processes of nature (spatial, temporal, causal, etc.) exemplify serial order. As noted earlier, the syllogism is but one special instance of the transitive relation.

In order to suggest the importance of this, let me refer to the following examples of isomorphic structure, which exemplify the properties of serial order:

(1) A good map and the territory it represents.

(2) The plot of a novel and the moving-picture reproduction of it.

(3) The inverse-square law as it is illustrated in gravitational attraction and electromagnetic phenomena, and as it is illustrated by the decrease of intensity of light and sound with the square of the distance

(4) The similarity between the score on a musical sheet, the music as a series of air vibrations, the electrochemical changes carried over the auditory nerve of the listener, and the experienced melody and harmony in consciousness.

(5) In visual perception, the similarity (isomorphism) between the external pattern, the corresponding retinal mosaic, and the phenomenal image in consciousness.

(6) The last two examples take us into the field of gestalt psychology. One of the properties of a *Gestalt* is that it can be *transposed*. A melody, for example, is a *Gestalt* (configurational whole) because it can be played in different keys, and the "same" melody in any key has the original logical structure or form.

Thus it appears that gestalt theory is only a special case of the theory of isomorphism. This is recognized and admitted by the advocates of gestalt theory. For example, in his book *Gestalt Psychology* Professor Köhler states[7] the following principles: "all experienced order in space is a true representation of a corresponding order in the underlying dynamical context of physiological processes," and "experienced order in time is a true representation of the concrete order in the underlying dynamical context." All

[7] *Op. cit.* (1929), pp. 64–65.

that means is this: there is an isomorphism between the conscious experiences and the corresponding series of physiological events. If any investigator desires to refute gestalt psychology, all he has to do is invalidate this assumed one-to-one correspondence.

As we have seen in Chapter XV, this notion of transposability of forms from one situation to another with an isomorphic structure is fundamental to the theory of intelligence which gestalt theory has put forth. The "gestalters" have much to say about *insight*, and this appears to be the ability to see a situation-as-a-whole and react to it in an appropriate manner. Elsewhere the writer has tried to show[8] that insight is not a mysterious gift that functions independently of previous experience, but is only another name for something that logicians have long been familiar with under the name of "reasoning by analogy." Intelligence, insight, the ability to formulate brilliant scientific hypotheses are all examples of seeing an analogy between the present situation, which presents us with a problem to be solved, and some relevant previous situation that has already been adequately handled. In every case the process illustrates the familiar formula $A:B :: C:D$. In general, in so far as a present problem resembles a previous one, to that extent the new solution will resemble the old one.

This is not the place to enter into the details of the logic of analogy, though the widespread use of analogical reasoning indicates the fundamental importance of the subject. It must be remembered, however, that some analogies are fruitful, as a knowledge of the history of science shows, and it is for this reason that they are able to run the gauntlet of scientific criticism.

In order to illustrate the manner in which the study of logical form finds practical applications in the social sciences, while yet carrying forward the exposition of the humanistic philosophy we are here presenting, we shall, in the following chapters, exhibit how the gestalt hypothesis can be utilized in the interpretation of social phenomena.[9] We shall see that it *is* possible to *transpose* the familiar principles of organismic behavior to the social system. Until recently it has been assumed that this theory—so much

[8] Cf. my article "The Logic of Gestalt Psychology," *Psychological Review*, Vol. 38, 1931, pp. 359–368.

[9] In his interesting volume, *Scientists Are Human*, Dr. David L. Watson has developed a similar line of thought. The important work of Dr. George P. Conger, *A World of Epitomizations*, also throws light upon the logic of organismic situations.

overworked by the post-Darwinian enthusiasts—was dead, a fossil of the mental evolution of the human race. But now there are signs of its rebirth. Both the *cultural interpretation of history* and the recent ideas of gestalt theorists fall back upon ideas that are strongly reminiscent of the earlier organismic theory. As we now propose to show, the notions of organismic unity through physiological gradients (Child), control of behavior through pacemaker reactions (Hoagland), the attainment of organismic coördination through specialization of structure and integration of function—all these have their analogues in the social processes of human aggregations.

CHAPTER NINETEEN

GESTALT PSYCHOLOGY AND ORGANISMIC THEORY[1]

For the first time in the history of humanity, a crumbling civilization is capable of discerning the cause of its decay. For the first time it has at its disposal the gigantic strength of science. It is our only hope of escaping the fate common to all civilizations of the past. Our destiny is in our hands.

—ALEXIS CARREL

I. PHILOSOPHY AND EDUCATION

Auguste Comte, the famous French philosopher and reputed founder of the science of sociology, presented the idea that human thought, in its evolution, passes through three stages: the theological, the metaphysical, and the scientific. For Comte, the positivist, the third stage, that of scientific description, represents the final goal of intellectual and social evolution. More recently a well-known expounder of behavioristic psychology, with an uncanny ignorance of the history of human thought, stumbled across a similar generalization and announced that in fifty years philosophy would be dead. Naturally enough, for this Behaviorist all philosophy belongs to Comte's second level, that of metaphysical explanation.

No doubt it would be rash to attempt to prove that philosophy will live forever. But the more modest thesis, that so long as the special sciences are incomplete and growing and there still remain frontiers of cultural advance, philosophy will continue to have a proper place in the life of society—this thesis almost any philosopher would be willing to defend. One presupposition behind the writing of the present volume is the belief that for the immediate future, at least, philosophy must become even more vital and important. This view rests upon a particular conception of the nature of philosophy of which the present chapter is itself an

[1] The present chapter first appeared in the *Journal of Social Philosophy*, 1939, Vol. 4, pp. 260–271.

application and justification. Explicitly stated, my first assumption is this: *One important function of philosophy is to formulate general hypotheses, tentative solutions to problems and plans of action, which are then to be tested out empirically in the world of facts.*

An examination of this assumption will show that it commits us to the view that what passes as science today is nothing other than a standardized philosophy which generations ago became accepted by a group of "experts" in some given field, and was passed on as the common property of that science. Thus the content of any "science" is the tested and verified residuum of that highly specialized form of folkways which is termed "scientific method." Science, on this theory, may be inseparably linked with the "laboratory," provided in the social sciences we are permitted to think of society as itself being a laboratory. I am at pains to make clear the general presuppositions of this view because the validity of my next assumption rests upon the soundness of this more general basis. My next postulate, then, is this: *Education in general—or any particular educational system—is simply a socially accepted (conventionalized) philosophy in action.* An educational system is a technique for passing on to subsequent generations those cultural ideals and practices that any given social group deems worthy and desirable. This is true whether the education, the philosophy in action, we are considering is that of a primitive group or a complex modern society. In primitive group life, we find that the educative process works through customs and traditions which are transmitted, almost unconsciously, from generation to generation through the various media of social heredity. But modern societies also have their generally accepted body of ideals and practices. These are the "socially conditioned premises" of our thinking—the axioms of the culture that are taken for granted. In an age of transition, of the disintegration of the old, if not the synthesis of a new system, we are forced to become more critical about our assumptions. We challenge the "axioms" of our culture. But this is only another way of saying that we then grow more philosophical in our thinking about education. If education is simply a standardized philosophy in action, the business of building up a new educational system to meet the demands of a new world is simply the business of thinking out a new philosophy. We see, therefore, that—contrary to the positivistic-behavioristic view—the need for

philosophizing grows more insistent with the increasing complexity of the modern world.

Apparently one of the main troubles of today is that such philosophical criticism has disrupted our confidence in the old theories and techniques and hasn't given us a new set of beliefs and practices to take their place. This brings us to the third thesis of the argument: *Every educational theory, or philosophy in action, implies two things—*

(1) *a theory of the nature of the organism to be educated;*

(2) *a set of social ideals which are to be instilled into the organism to be educated.*

It is obvious that these two desiderata of an educational theory are and ought to be closely interconnected.

The fourth assumption is a continuation of the preceding postulate. With reference to (1), a theory of the nature and possibilities of the learning individual, it states that at the present time gestalt psychology provides the educator with the best, or most adequate, theory of human nature. It is here assumed that gestalt theory is superior to behavioristic psychology as an explanation of the facts of organic behavior.

The fifth thesis is that, with reference to desideratum (2), *the organismic theory of society not only contains a realistic analysis of the nature of society, but also furnishes the ideals essential to the outlook of an educated person of the modern world.* While this last proposition is stated as an assumption, it is the one thesis we purpose to demonstrate in the present chapter.

We are here not so much concerned with the question of fact as we are concerned with an ideal: What kind of society should we strive to create? We are not now so much concerned with the question of whether, as a matter of fact, society today is more like a "mechanism" than an "organism"; rather are we trying to formulate normative principles to serve as guides for the future evolution of society. In this connection it is proposed that we should refashion society in such a way that it functions *as if* it were an organism of a certain type. As a matter of fact it can't help functioning as some sort of organism, because it *is* one already. The question of fact is already decided in the sense that society possesses one attribute which a mechanism does not possess: mechanisms do not organically reproduce themselves in the manner characteristic of societies. It may be, as some experts argue, that

reproduction is not the most fundamental property of living systems. Perhaps selective permeability of membranes, associated with metabolism, is more fundamental than reproduction. But even this attribute has its analogue in the social system, for emigration is a kind of migration of substances (individuals) through semi-permeable boundaries, and perhaps diffusion of culture might also be thought of as a kind of spiritual osmosis.

In stating that we should strive to refashion society in such a way that it becomes an organism *of a certain type*, we have in mind the ideal of a complex organism that can exist as such because its manifold functions are well integrated into an organic whole. At the present time society resembles to some extent a mechanical mixture, because its differentiated structures (social classes, cultural groups) do not function as a harmonious whole. Having reached a certain stage in cultural evolution, the mechanical mixture of world states can move on to a new level of social synthesis, or functional co-ordination of activities, or it can fail at attaining the new type of organismic whole and lapse back into earlier and more primitive modes of existence. Certainly it cannot stand still, since the industrial revolution started processes that will either compel states to find a new organ to unify the activities of political-economic differentiations, or, failing that, these processes will bring about the destruction of these states themselves. At the present time we have no culture-patterns for civilization as a whole; there is no technique for international living; at the moment the very term "international law" is a misnomer.

What is it, then, that we need to think and do to achieve this new level of social synthesis? Here, I suggest, the organismic theory of society may be of service.

Before entering upon that investigation, however, let us point out that those who are engaged in this undertaking of framing normative principles in harmony with the organismic theory and gestalt psychology are neither babes in the woods nor prophets crying in the wilderness. The organismic theory of society is not a new idea, nor is it so old and ingrained that it is part of our native social endowment. If it has suffered from the vague generalities of the "system maker's vanity," and the over-enthusiasm of boom sociologists, it has nevertheless profited from the rigid criticism and has thus in time become a mature doctrine. In its present form it has been defended by several noted biologists, who

know what an organism is, and what a society must be in order that it may be like an organism. One stock criticism of the organismic theory of society has been answered by Professor Charles M. Child, as follows:

> Objections such as those that human society is not a big animal, that it has, for example, no stomach, no muscles, etc., etc., are just as true of many organisms as for society. It has been said that the social mind has no sensorium. But do not individuals in relation to each other and to the environment constitute the sensorium of the social mind just as truly as the cells and cell groups in relation to each other and to the external world constitute the sensorium of the individual mind?

Other instances of analogies between biological and social organisms have been presented by Walter B. Cannon in his book *The Wisdom of the Body*. We shall consider several of these parallels in a moment.

Since it is the thesis of the present chapter that the cultural interpretation of history, the organismic theory of society, the theory of emergent evolution, and gestalt psychology all share the same foundational idea of a whole that integrates and controls the part-processes, I shall use such terms as cultural patterns, organismic wholes, and social *Gestalten* interchangeably. These several concepts are analogous to the notion of *field* properties in physics. The specific characteristics of a *Gestalt* ("configuration") were first enunciated by von Ehrenfels in his doctrine of *Gestaltsqualitäten*. The criteria of a *Gestalt* or organismic whole are two: (1) the properties of the whole are not a sum of the properties of the constituent parts, and (2) the *Gestalt* can be transposed: it is like a melody (form) that can be played in different keys. In mathematical terms this means that the function of the sum is not a sum of the functions. And in terms of evolution this means (See *Philosophy and the Concepts of Modern Science*, *passim*) that there are two types of simplicity in nature: (1) simple simplicities, and (2) complex simplicities. Simple or first-order simplicities are homogeneous and isotropic, whereas complex or second-order simplicities are inhomogeneous and anisotropic. We have argued that nature is never satisfied with simple simplicities, but always moves on to the attainment of higher simplicities.

It was pointed out that *Gestalten* are transposable. Transposability involves a comparison of forms that have similar *relation-*

structures. This similarity of logical structure may be either one of spatial pattern or of temporal pattern, or both, but in any case there is an isomorphism between the two configurations, as already noted in the previous chapter. Therefore, if culture-patterns are true *Gestalten*, they are transposable: between a higher and a lower culture there must be a similarity of relational structure, though of course the *relata* (constituent entities) are different. Both, for example, must embody patterns of dominance and subordination, and so on.

This brings us to the point where it is relevant to discuss specific instances of organismic patterns in society, which duplicate the patterns within the individual organism. The three examples of isomorphism we shall here consider are as follows: (1) organismic dominance through metabolic gradients; (2) the master reaction and pacemakers; (3) dominance through structuralization. These instances of *Gestalt*-transposition will be discussed in the order just given.

II. Physiological Gradients as *Gestalten*

We have already referred to the work of Dr. Charles M. Child, the eminent biologist, who stands as one of the leaders in the revival of the organismic theory of society. Professor Child is best known as the sponsor of the important doctrine of metabolic gradients. Part of the factual basis of this doctrine was established through a study of flatworms (planarians). Here it is found that the intensity of chemical change tapers off from the head end of the organism toward the lower metabolic rate of the tail, and that in asexual reproduction the organism divides transversely at the point near the secondary apex, where the metabolic gradient again picks up. This process indicates that levels of higher metabolic rate are dominant over those of lesser metabolic rate.

This work of Child on regeneration, leading to the idea of physiological fields to which the part-processes are subordinated, was started around the beginning of the present century. In his book on *Individuality in Organisms* (1915), Child pointed out that the origin of physiological individuality is to be found not in protoplasm alone, but in the relation between living matter and the external world. The primary effect of the stimulus on undifferentiated protoplasm is the increase of the metabolic rate at the

point excited. This excitation is then transmitted as a dynamic change over the protoplasmic mass, perhaps as a wavelike irradiation, which undergoes a decrement of intensity in its course. The result of continued or frequently repeated excitation "is the establishment of a gradient in the protoplasm, which constitutes a more or less permanent material substratum for a persistent metabolic gradient independent of the local external stimulus."[2] Thus "a relation of dominance and subordination exists between the level of the highest and the levels of the lower metabolic rate."[3] These metabolic gradients or axes of polarity and symmetry are the expression of physiological unity, the starting point of organization, and the factors determining growth and differentiation.

Of course the mention of the term "organization" will call to mind the more recent investigations of Spemann, and raises the question of the relation between Child's gradient hypothesis and Spemann's notion of "organizers." H. Spemann and O. Mangold have discovered that at an early stage in the development of certain organisms it is possible to transplant groups of cells that normally produce their own tissues and organs. The results of such transplantation experiments indicate that in some cases the fate of cells is regulated by their relation to other cells of the organism, and the part of the tissue that is not altered, but modifies the implanted part, is termed the "organizer." Professor Spemann[4] indicates that he has some difficulty in accepting the notion of fields and gradients as factors in form production, but it still remains true that Child's hypothesis is the best thus far developed to cover the phenomena in question. Actually these two theories conflict no more with each other than they do with the generalizations of G. E. Coghill who, from another angle, also shows how the organismic whole helps to determine the differentiation of part-patterns in developing behavior.

It is true that Professor Child has not told us how the gradients that are established in the individual, or ontogenetically fixed, can hereditarily determine the organization of structure in the phylogenetic series. He has not advocated the idea that the recurring types of stimuli might in time build up permanent sub-

[2] Child, *Op. cit.*, p. 34.
[3] *Ibid.*, p. 36.
[4] Cf. *Experimentelle Beitrage zu einer Theorie der Entwicklung*, by Hans Spemann, Berlin, 1936.

strata of response, such as the highly specialized pathways that constitute nervous tissue. The view that in ontogenetic development functional stimuli might regulate the growth of cells, and that the differentiation of tissue thus produced may acquire phylogenetic structuralization, is usually taken to imply that function builds up structure. Although Child has not subscribed to any form of Lamarckian theory, such as that of McDougall, Semon, Rignano, Hering, or Samuel Butler, nevertheless in a later book on *The Origin and Development of the Nervous System* he does point out that the nervous system is not a new integration superimposed upon protoplasm, but is rather a product of the primary integrating factors—chemical regulation, for instance, which makes the organism an orderly whole.

One might have hesitation in carrying over these ideas into the social field, were it not that Professor Child has himself set the pattern by making such applications. Thus, in his volume *The Physiological Foundations of Behavior*[5] he states: "The organism is a dynamic order, pattern, or integration among living systems or units. A social organization is exactly the same thing." Professor Child later carried these ideas over into the field of sociology in an article on the "Biological Foundations of Social Integration."[6] Here, as in the individual organism, the relations, not the parts, are the integrating factors.

Now if we accept this analogy (isomorphism) between organisms and societies, and if we agree that physiological gradients are true *Gestalten*, we must expect that we can transpose the relation-structures from one field to the other; that, in other words, social patterns will also embody levels of dominance and subordination, the entire whole constituting an organismic whole. Such culture-patterns or social *Gestalten* are illustrated on a lower level by W. M. Wheeler's work on the social insects. Friederich Alverdes, in his book on *Social Life in the Animal World*, has also pointed out that mass psychology "proves the truth of the dictum that the whole is not merely the sum of its parts."[7] According to this student, this principle is illustrated in colonies of ants, bees, wasps, etc., and applies to such functions or cultural patterns as singing, panics, etc. Similar social integrations of an

[5] 1924; p. 270.
[6] *American Sociological Society Publications*, 1928, Vol. 12, pp. 26–42.
[7] P. 14.

organismic type appear on the human level. One investigator, R. D. MacKenzie, argues[8] as follows: "The spatial distribution of human beings and institutions is not accidental. On the contrary, it is a product of evolution and represents a dynamic functional interrelationship in which the units are organized around centers or points of dominance. The pattern is not unlike that of the living organism, which, as Child points out, is a vital integration of organs, cells, and tissues functioning in harmony with centers of dominance. Moreover, human, like biological evolution, reveals an ongoing tendency toward a more specialized and refined relation between the centers of dominance and the subordinate integrated parts. The development of communication is rapidly transforming the world from the smaller, undifferentiated symmetrical unit of spatial distribution into the highly centralized and specialized axiated type." Thus we discover instances here of an isomorphism between structural organization within the developing organism and the structural organization within an evolving society.

We shall return to this matter in a moment, after we have examined the role of "pacemakers" in the regulation of organismic patterns.

III. Master Reactions and Organisms

In 1908, T. Brailsford Robertson pointed out[9] the similarity between growth curves and the graph of an autocatalytic monomolecular chemical reaction: both give a characteristic *S*-curve. Since the rate of a complex group of chemical reactions can be no greater than that of the slowest one of the group, Robertson proposed the theory that the "master reaction" of growth is a monomolecular autocatalytic reaction—it speeds up as it goes along. Robertson also observed that this formula holds for the improvement of memory with repetition and pointed out that the Weber-Fechner law of psychophysics is in accordance with this autocatalytic formula. Later, A. P. Mathews and G. W. Crile also noted the curious resemblances between linseed oil and protoplasmic respiration, memory, and growth, and this seemed to lend

[8] In an article on "The Concept of Dominance and World Organization," *American Journal of Sociology*, 1927, Vol. 28.

[9] "Sur la dynamique du système nerveux central," *Archives internationales de physiology*, 1908, Vol. VI, p. 388.

some confirmation to Robertson's theory that the fatty acids are fundamental in an organic autocatalytic process. Other investigators showed that the *S*-shaped curve of growth not only applies to the growth of human individuals and the activities within the living organism, but applies also to the growth of plants, the growth of bacteria in a culture, etc. Raymond Pearl later extended this idea to the growth of human populations, supposing that each country fits into the *S*-curve at some point.

Although this theory and its various derivatives have been much criticized and are no longer fully acceptable, at least in their original forms, we need to keep in mind that it is quite probable that some sort of law is transposable from individual growth to the growth of colonies; for, as A. J. Lotka points out in his *Elements of Physical Biology*,[10] the body of a multicellular organism is itself a population of cells. The great value of Robertson's speculations is that they gave an impetus to the application of chemical laws to biological, psychological, and later social processes and behavior.

Further applications of this idea of the influence of the "master reaction" take us into that version of it which Hudson Hoagland has discussed under the term "pacemakers."[11] From Loeb's observation that life depends upon a series of reactions that proceed at rates bearing a definite relation to each other, Professor Hoagland passes on to the further generalization that life (at least in its simple forms) depends primarily upon the relative order of magnitudes of velocity constants of a series of linked reactions. According to Hoagland, those commonly recurring reactions (few in number) may act as pacemakers for a great variety of different events in protoplasmic systems. Following up this general idea, Hoagland is led to the specific deduction that, since the rate of physiological reaction depends upon an underlying chemical master reaction in the cells of the brain, modifications of the internal body temperature might be expected to alter judgments of time intervals in a way consistent with the Arrhenius equation relating velocity of chemical reactions and temperature. In the case of the human individual, the master reaction is not only a physiological pacemaker; it is a chemical clock located in the nervous system which furnishes its possessor with a subjective

[10] 1925; p. 76.

[11] See *Pacemakers in Relation to Aspects of Behavior*, 1935.

(conscious) time scale. Experiments were carried out to test this theory, and it turns out that in patients suffering from fever, and in those in whom high body temperatures are induced by diathermy treatment, judgments of time (of short duration) *do* vary in the predicted manner!

Although this underlying master reaction is probably an irreversible chemical process (perhaps respiratory in nature), nevertheless recent work with electrical recording techniques has shown clearly that continuous irreversible changes in the cells of the nervous system may produce rhythmic and repetitive activity, discharging impulses over efferent fibers at frequencies directly proportional to the rates of chemical changes going on in the centers.

In a search for social analogues for Hoagland's version of biological master reactions, two possibilities occur: one is to seek for pacemakers in society, the slowest social activities that regulate the rate of social processes; the other is to investigate the possible social parallels for the conversion of continuous into rhythmic and repetitive processes. In connection with the first possibility, one might suppose that just as an army travels on its belly, so, in general, the rate at which food and fuel (energy) can be made available constitutes a kind of pacemaker. In connection with the second line of development I am indebted to Professor Hoagland for one suggestion. He calls attention to the fact that repetitive processes are illustrated by the "relaxation oscillation," and that this might be applied to such things as economic cycles. In general, any process that calls for a continuous building up of a reservoir until a critical point or potential is reached, after which some discharge occurs, might be suspected of illustrating such release, or "relaxation oscillation," processes. Before leaving this matter it might be interesting to note the fact that Hoagland has shown[12] that the "Berger rhythms," due to alterations of electrical potential in the brain, also proceed (in frequency) in accordance with the Arrhenius equation, so that if there is a valid analogy between individual organisms and the social organism, some sort of social correlate should be discoverable, at least if there is anything in society analogous to a "sensorium." The fact that one of these cortical frequencies is

[12] *Science*, 1936, Vol. 83, p. 84.

abolished by the inception of a thought process may suggest the type of integration (synergy) we shall need to establish in society in order to abolish the social (economic?) correlate, if that cycle should prove to be of the harmful type.

IV. Building the World Sensorium

The two previously discussed methods of securing unity of behavior are through dominance *via* metabolic gradients and co-ordination *via* master reactions that regulate a chain. These two types of control do not conflict. The third way of securing organismal co-ordination is through the evolutionary elaboration of a special organ or unification. In the more complex living forms the central nervous system is the organ par excellence of synthesis. Once nature discovered the "integrative action of the nervous system," she capitalized upon the invention and moved right up the "tree of life" through ever-increasing cephalization. In the higher primates the cerebro-spinal axis provides a structural organ with a hierarchy of levels of response ranging from spinal reflexes at the lower end to the highest cortical synthesis of an Einstein, who seeks unity in nature because nature has endowed him with a brain and a personality that demand unification. The brain is the "specific organ of civilization" because it makes possible conscious purpose and intelligence—the projection into the future of the lessons learned from the past.

And this brings us back to the place of philosophy in the social organism. We have argued that if the actions characteristic of the potentially conflicting groups within our complex society are not to render unity of action altogether impossible, a new social philosophy will have to be evolved. This proposed intellectual synthesis, we hold, will be the new humanism. In this view the harmonization of desires with each other, and the sublimation of instinctive urges into higher energy-escapements, is the individual parallel of the creation of the necessary social institutions that will harmonize the otherwise conflicting interests of social classes and nations. In both cases this is a matter of intellectual unification. Between the individual and the social there is thus an isomorphism of structure, a transposable *Gestalt*.

The building of the world-consciousness, the international mind, that must replace the economic nationalism and patriotic motifs of present-day mentality, is the next objective of education. As

we have already indicated, this means that in the coming years *the nations of the world will have to evolve for the social organism a world-sensorium*, a center of intellectual dominance similar to that which nature provided for individual organisms when she produced the cerebral hemispheres, the vehicle of highest metabolic rate and the synthesizer of reactions. Until a level of social integration, or unification of the world's cultural patterns, is attained; until we have an organ to centralize and co-ordinate the complexity of function of the emerging social organism, our humanitarian aspirations will continue to suffer defeat.

In the next chapter we must deal at greater length with this theory of the coming world-sensorium. In doing so we return to some ideas that were anticipated in the last chapter of Part II, where we briefly touched upon the subject of emergence and extrasensory perception.

CHAPTER TWENTY

HUMANISM AND EXTRA-SENSORY PERCEPTION[1]

A civilization which cannot burst through its current abstractions is doomed to sterility after a very limited period of progress.

—A. N. WHITEHEAD

I. FACTS AND THEORIES

As everyone knows, the belief in what is termed "supernormal" phenomena is very old. In recent years investigators in the field of psychical research have attempted to study such phenomena—"clairvoyance," "telepathy," and the like—under laboratory conditions. The results, real or spurious, have provided the occasion for much controversy. Among the recent investigations along this line we find the tests made by Dr. J. B. Rhine at Duke University. The results of these experiments seem to Dr. Rhine to justify the belief in what he terms *extra-sensory perception* (ESP). Dr. Rhine and his co-workers believe that they have considerable data supporting the genuine reality of clairvoyance and telepathy, and they maintain that the conditions of the experiments and the mathematical handling of the results are sufficiently beyond criticism to convince anyone who is reasonably open-minded. It goes without saying, however, that the critics of this work do not agree with this thesis.

Whatever may be the final conclusion, these investigations in the field of extra-sensory perception have attracted much attention. Attacks upon and defenses of this work in parapsychology (as it is called) have been frequent and lively. The present writer has witnessed some of these experiments and has been in touch with some of the individuals doing this work, and has finally arrived at the conclusion that "there may be something in it." As I

[1] The present theory was first presented in *Psyche*, 1937 (London), and was later expanded in an article on "Humanism and the World Mind," in the *South Atlantic Quarterly* (April, 1939), and in a following article on "A Theory of Extra-Sensory Perception," in the *Journal of Parapsychology*, 1939, Vol. 3, pp. 167–193.

try to understand the unwillingness of Dr. Rhine's critics to go along with him in his statement of "facts" and theories, the conclusion has forced itself upon me that the opposition to his work is due in a large measure to our present inability to explain such results. This of course is a familiar mode of reasoning. It is the old "argument from inconceivability" set in a new context.

In the present chapter I shall outline a theory that attempts to provide an explanatory foundation for extra-sensory perception. The aim of this presentation is not to try to prejudice the reader in favor of Dr. Rhine's conclusions, but merely to remove one difficulty that has made it impossible for some to approach this field with an open mind. The facts must be judged quite independently of our ability to explain them, but if a theory can be invented that will show how such facts might be understood, it may contribute toward the development of a more objective attitude in a highly controversial field.

In the present view, as we have constantly reiterated, we are not defending a dualistic theory of psychology. Our theory rigidly excludes supernaturalistic ideas; it excludes the miraculous and the inexplicable. The elements that enter into the construction of the present theory have already been defended in the previous pages, quite apart from their relevance to the field of psychical research. The constituent elements of the theory here offered are these: (1) the theory of emergent evolution; (2) the system of reasoning termed "non-Aristotelian logic;" (3) the notion of a psychic ether; and (4) the doctrine known as "religious humanism." Now we aim to bring all these ideas to a focus on the phenomena of extra-sensory perception.

It will be noticed that the last constituent element of our theory takes us into the field of religion. It will be obvious to the discerning that the ultimate aim of our enterprise is nothing less than a new theory of biological and mental evolution. Contrary to the view of those who hold that religious and philosophical considerations have no place in the development of a scientific hypothesis, I hold that what the world needs today is a synthesis that will bring together the interests represented by science, art, religion, and philosophy. Before entering into the technical details of this new outlook, let us glance at the philosophical presuppositions of our theory.

II. The Need for a New Philosophy

It is obvious that the world is undergoing a profound reorganization in thought and in social relations. To some students of society these fundamental readjustments are evidence of a general disintegration of European-born civilization as it passes into a new Dark Age, while to others, less pessimistic in outlook, these rapid and disturbing changes appear as the prelude to the emergence of a new type of culture. For the moment the question of which view is correct need not concern us. It is sufficient to note that in this environment of dislocations, where problems are so numerous and difficult that their solution seems to demand almost superhuman effort and intelligence, there is always danger that perplexed nations, like human individuals, will seek to dispose of apparently insuperable difficulties by adopting the devices of the mentally immature. Confronting an environment too perplexing for mastery, some individuals succumb to atavistic tendencies and return to simpler and more primitive modes of adjustment, such as are natural to a child. These mental regressions represent an escape from reality; here problems are solved by being ignored.

At the present time the nations of the world are faced by the necessity of evolving a new machinery of international understanding and co-operation. In the presence of this unprecedented demand there is the constant temptation to resort to social atavism. It may appear far-fetched to compare nationalism and political isolationism to the withdrawing reactions of an insane man, and yet the unwillingness to enter into a new level of integration does resemble the infantilism of an "adult" who seeks to return to the world of the child because he cannot adjust himself to the world of grown-ups. That is to say, fascism, economic autarchy, and the like appear as regressions to earlier forms of political-economic organization which ought to be outmoded in the present world of interdependent units. These obsolete forms linger on primarily because we haven't yet discovered a method of creating positive techniques of international living. The disturbing thing is that even though we recognize the antiquated nature of these survivals, we can't put them where they belong—in the archaeological museum of social fossils.

If we think this situation through, it begins to appear that the fundamental difficulty here is largely a result of the failure of

philosophy. Excessive nationalism is rampant because we have deep-seated urges that must canalize themselves through emotional outlets but, lacking any higher modes of expression, are forced to manifest themselves through the older forms of expression embodied in our inherited institutions. The political state, collapsing through the inherent frustrations of economic maladjustment, preserves itself by supplying the justification and occasions for such emotional orgies, paying the piper for the song by mortgaging the uncreated wealth of future generations. In an earlier age religion provided the needed emotional outlet, but modern science has all but destroyed the authority of the older religious appeal, without supplying any substitute. Men cry for a goal, for a purpose in life giving meaning to action. Finding nothing in the domain of contemporary science and religion, men allow themselves to be led back to the ancient fleshpots, the age-old outlets of chauvinism and social egotism (nationalism). Thus mass feelings find energy-escapements through atavistic forms of culture, and men worship the old tribal gods and pray at the shrine of hollow nationalistic personifications, knowing in their hearts that they have moved into a new world where men must find the "Unknown God"—else they perish.

Here and there we see evidence of a breaking with the old forms and techniques. But as we rise above the past, we experience its power to drag us back. None the less—and in spite of setbacks—we do glimpse the form of a new world order emerging: a world-state guided by a world sensorium and animated by a social consciousness born of science. Through radio, telegraph, rapid transit, and newspapers, a consciousness-of-the-world is being transformed into a world-consciousness. The new organ of integration is gradually crystallizing its own skeleton. Eventually the political, economic, and religious motives will again unite, producing a philosophical synthesis quite radical and startling in character.

Let us see how this will come about.

On the physical side, the world is growing into a new unity through manifold processes of integration. When the problem of wireless communication was solved, the range of man's auditory environment was enlarged to the point where we can now hear sounds at practically the same moment that they are produced in any other part of the world. The radio has thrown around the

world a girdle that greatly extends man's environment. In a similar way the moving picture has projected man's visual world beyond the ordinary limitations of time. Events that happened in distant places and at former times can now be reproduced at will. Thus the instruments which enable us to transcend the normal restrictions of time and space not only are changing the content of our thought, but also are *intensifying our awareness*. The instruments of publicity—radio, newspapers, television, etc.—are now accepted institutions of society, and these are making us more aware of each other and of ourselves. By enlarging the sensory environment we are changing the inner life of the organism.

But how does this undoubted unification of the world through science contribute to the formation of this emerging synthesis that we have described as a new world religion? This question we now propose to investigate.

III. The Future of Man

We have referred to the consciousness-of-the-world that is developing. This phrase implies that we are all growing more *aware*, that our sensitiveness to reality is becoming richer and deeper and more intense. That this increased capacity for experience is related to the increasing complexity of man's physical and social environment is an idea we have already suggested. This must be so, if man's consciousness is social in reference. But on the biological side we have equally good reason for believing that, as we enter into new environmental (social) relations, our inner life expands. Thus the view that mind has reached its apex, that the wave of consciousness has finally and for all time reached its culmination in man *as now constituted*, is neither good sociology nor good biology.

To those persons whose thinking starts and stops with the "special creation" theory, the idea that man is still in the process of being created may come as a shock. We might suggest in passing, however, that if one is looking for religious sanctions for this view we can always refer to the utterance of that ancient voice of hope—*it doth not yet appear what man shall be!* Whether we like it or not, the fact is that we are living in a world which is still incomplete. The philosopher Nietzsche, sometimes miscalled the anti-Christ, saw clearly that *man is a bridge;* like the ape, he exists

for what is to come after. Man must go beyond himself; he will be superseded by the superman. This coming man, however, will not be the creature imagined by Nietzsche. Instead of raising certain of our present human attributes to the *n*th degree, he will possess new psychic capacities not manifested at the present time in any considerable proportion of the human race. To show that such psychic functions as we are attributing to our future humanity are within the range of scientific possibilities, let us begin by looking at evolving man from a biological point of view. Here we have recourse to the views expressed by several eminent students in the field.

In his address before the American Philosophical Society, meeting at Philadelphia in 1929, Dr. Ales Hrdlicka argued that man, a product of biological evolution, is still evolving, and that there is practical certainty that his future evolution, as in the past, will be mainly in the direction of intellectual development. It is quite true that some biologists have argued the contrary view, assuming apparently that the limit of man's physical evolution has been reached, so that the next step lies in taking advantage of the vast potentialities of social evolution. Although this is a debatable matter, Dr. Hrdlicka maintains that the further mental development he has postulated may be expected to be attended by an additional increase in brain size, although this gross increase will be of moderate proportions. The main changes, he thinks, will be in the internal organization of the brain, in a greater blood supply, and in an increased effectiveness in the use of the brain.

Along somewhat the same lines, we find Dr. Frederick Tilney holding that, even though it is true at the present time that we make use of only one-fifth of our brain, nevertheless the brain of modern man is not a finished product. Remembering that the first-known man made his appearance hundreds of thousands of years ago, and that since then man's brain has increased in volume and acquired greater refinements in structural detail, it seems likely to Dr. Tilney that the present brain represents an intermediate stage in its ultimate development. In his treatise *Brain Evolution from Mammal to Man*, Dr. Tilney reviews this steady advance, and then puts the question: "Is there still a possibility of further evolving in the development process so clearly seen in the brain of primates, so obviously reaching its present culmination in the brain of man—is there still a latent power in the human brain for

the expression of yet unsuspected potentialities and beneficial progress?" This question was recently answered in positive terms by another student of living organisms, Dr. Alexis Carrel, in his book, *Man the Unknown*. Here these "unsuspected potentialities" turn out to be psychic powers such as have apparently been possessed by those who claim the "occult" gifts of clairvoyance and telepathy.

IV. The Evolution of Reasoning

The view that is here being advanced as a tentative hypothesis is in some respects similar to that put forth by Dr. Carrel, except that I wish to add that the changes which may take place may be so fundamental and far-reaching as to involve the substitution of a new logic for the older logic that the human race has been employing for thousands of years. This new mode of thought may call for a revision of the ancient "laws of thought" that have regulated thinking ever since the time of Aristotle. In order to be concise, let me state at once that we are here again proceeding on the supposition that the evolution of human mentality during historical times may be summed up under three stages, as follows: (1) the pre-Aristotelian period; (2) the Aristotelian period; and (3) the non-Aristotelian period. We hold that primitive man functions on the first level of human mentality; that the human mind of today (of civilized nations) is functioning on the second level of Aristotelian logic; and that in the future the human mind will move on to the third level, the level of the non-Aristotelian mode of understanding.

Now let us briefly consider the characteristics, the "axioms," of each of the above three levels of orientation.

(1) *The Pre-Aristotelian Mentality.*—Here we have the stage of primitive man, who deals with nature in terms of wholes. The researches of Lévy-Bruhl have revealed that the primitive mind is "pre-logical" in the sense that it does not conform to the categories which the reasoning of classical European science has established. Lévy-Bruhl is convinced that primitive man does not observe the fundamental canon of Aristotelian logic, the law of contradiction, but follows an entirely different principle which he designates by the term "participation." On the first level, the pre-logical mode of adjustment, the axiom is: "Everything is everything else." Thus primitive man's personifications of nature are based on what

have been called false identifications—"I am other things." The "animistic" system is an expression of mystical participation in the sense that it does not distinguish between the self and the not-self. There are no sharp dichotomies in nature, because the Aristotelian "laws" of identity, contradiction, and excluded middle are not respected.

(2) *The Aristotelian Mentality.*—On this next level of mental-social evolution we get sharp distinctions in nature. The reasoning on this level of orientation is based on the familiar "law of identity," that *A* is *A*: everything is identical with itself and distinct from the "other." Here the axioms are "This is this," and "That is that," and "This is not that." This logic involves a sharp distinction between an "object" and its "environment" and dichotomizes the self and the not-self. This is the logic of modern science, which undoubtedly took over the presuppositions of Greek (primarily Aristotelian) logic. Here, unlike primitive man's orientation, there is a separation of reasoning and emotion into distinct faculties, and the activities of science are connected with man's rational life, while the affective responses are excluded from science (reasoning) and left to the domains of religion, poetry, and "metaphysics."

(3) *The Non-Aristotelian Mentality.*—In proposing that the third stage of mental evolution is, or will be, the non-Aristotelian mode of orientation, we mean that after the present age of specialization in science has passed, or has been supplemented by an era of coordination and synthesis of knowledge, we shall attain an insight into the interconnectedness of things which will resemble primitive man's sense of "participation" in the sense that here, on a higher level, we again realize the limitations of the classical laws of thought. On this coming third level we return to the idea that "Everything is everything else," except that this non-Aristotelian principle (unlike the pre-logical principle of primitive mentality) will be based on an understanding of an underlying unity, provided by a sub-universe of continuity, so that the distinction between "object" and "environment" becomes relative. Individuality (identity) is to some extent illusory. In its ethical application this means that it is really true that we are our brother's keepers, and that he who would find his life must lose it.

We have already noted that one significant feature of the science and philosophy which develops in connection with Aristotelian

logic is the separation of intellect and feeling, reason and emotion. The present emphasis of positivistic philosophy on the study of cognitive meanings and the rigid exclusion of emotional elements, allegedly because of the affinity of feeling with poetry and religion, is only the latest consequence of this schism. The present impasse between sterile intellectualism and irrational emotionalism, running through the whole of modern life and separating religion and politics from the life of reason, is the unfortunate social consequence of this elementalistic psychology and cultural atomism. In the present organismic (non-elementalistic) view this dualism and the consequent mental conflict are resolved.

The essential unity of nature and life that we have suggested is easily recognized in mystical pantheism, and this attitude is difficult to "understand" precisely because of its super-logical nature. The intuitions of such a view are finely portrayed in Emerson's tantalizing poem "Brahma," from which the following two stanzas are quoted:

> If the red slayer think he slays,
>   Or if the slain think he is slain,
> They know not well the subtle ways
>   I keep, and pass, and turn again.
>
> . . .
>
> They reckon ill who leave me out;
>   When me they fly, I am the wings;
> I am the doubter and the doubt,
>   And I the hymn the Brahmin sings.

Such "mystical participation" is taken for granted in poetry. But that the present difficulties in science are due to the use of a faulty logic, and that their solution calls for a new mode of understanding in any way analogous to Emersonian pantheism, are things that require considerable proof. Nevertheless there is evidence indicating that the traditional "laws" dating back to Aristotle will have to be limited to their applications. The statement of Dr. A. N. Whitehead, that the world is in the midst of a most profound scientific revolution, only hints at what is coming. Not only have the new and revolutionary discoveries in physics upset our traditional ideas about the fundamentals of nature—space, time, and matter—but the reconstruction in our thinking that physics necessitates goes much deeper. Following Alfred

Korzybski's thesis, we have argued that the Newtonian world-picture was based fundamentally on Euclidian geometry and the traditional Aristotelian laws of thought, and that this Aristotelian-Euclidian-Newtonian scheme of nature forms one coherent pattern. But now relativity physics and wave mechanics compel a modification of this classical world-view, and the new picture will be non-Aristotelian, non-Euclidian, and non-Newtonian.

We hold that the development of this modified view calls for a rejection of the time-honored "laws of thought," which will be replaced by new principles of orientation. We shall not attempt here to show this in detail, since it has already been done in preceding chapters. But since I propose to show that Dr. Rhine's results in ESP also call for a rejection of classical science and the creation of a new scientific world-view, it is necessary at least to repeat what, from our point of view, is wrong with classical physics. To be brief it is necessary to be dogmatic, and I therefore merely sketch in outline what seem to be the fundamental assumptions of the classical theory of nature. These are as follows:

ASSUMPTIONS OF CLASSICAL SCIENCE

(1) Whatever is, is. (This is the "law of identity.")

(2) A thing is what it is.

(3) A thing is where it is.

(4) The same thing cannot be in two different places at the same time.

(5) Two different things cannot be in the same place at the same time.

(6) In order that any thing can get from one place to another, it must move through the intervening space, and it must take some time to do this.

(7) The same thing, or event, can be observed from two different points of view at the same time.

(8) Two different events can happen simultaneously, and they can be observed as simultaneous from the same point of view.

It is my contention that the discoveries of present-day science discredit the universal validity of these once-universally accepted axioms. For example, it is known to the experts that axioms (7) and (8) are upset by relativity physics, which rejects "simultaneity" of events in different frames of reference. That is to say,

Einstein was led to the special theory of relativity by challenging the traditional idea that two events can happen in *different* places at the *same* time. Again, to pass on to a simpler situation, the absolute truth of axiom (4) is challenged by evidence showing that, in a sense, *two bodies may occupy the same space at the same time* (this appears in quantum mechanics). Later on I shall indicate the evidence disproving axiom (6)—evidence showing that, in a sense, *the same body may be in two different places at the same time.* This means that certain supposed fundamental relations between objects (or "matter") in space and time (relations that classical physics took as axiomatic) are now discovered to be valid only within certain limits. Thus we now find that physics and logic must revise their ideas of what is "possible" in nature. Logic cannot escape this revision, because the "laws of thought" have historically been interpreted as laws of reality.

The significance of this development for ESP research can readily be seen by turning for a moment to Dr. Rhine's results. In experiments in which subjects were set to the task of calling cards at a distance of several hundred miles, the results that Dr. Rhine amassed, and reported in his book on *Extra-Sensory Perception*, indicate that the ordinary laws of radiation do not hold, and suggest that a non-radiant energy is at work in ESP. These facts of distance-clairvoyance and telepathy therefore bring us face to face with the circumstance that space relations, and possibly time relations also, are not binding for the mind as they were supposed to be for the physical world in classical physical science. If Dr. Rhine's results are valid, they necessitate the acceptance of a kind of energetics not limited by the customary inverse-square law; that is, there is no decrease of effectiveness of extra-sensory perception with increase of distance, as is the case for known energies. Since this physical law is a consequence of the geometrical properties of Euclidian space, and is necessitated by the Newtonian law of force, *the results obtained by Dr. Rhine really seem to suggest the need for a non-Aristotelian logic in this field.* Of course the validity of this argument rests to a considerable extent on the soundness of our prior thesis that Newtonian physics is indeed an exfoliation of the presuppositions of Aristotelian logic and metaphysics, as that synthesis was passed over the historical bridge of Euclidian geometry to become the conceptual framework of the

Cartesian-Newtonian mechanistic physics of modern science. The defense of this thesis was presented in Part I of the present volume.

V. Emergent Dimensionality

We have said that the theory of emergent evolution forms an integral part of the new philosophy of nature on the basis of which we attempt to erect a humanistic religion for mankind. Let us see how this is to be accomplished.

Various writers have different interpretations of the meaning of "emergent evolution." For us it is a name for the process whereby the ultimate "particles" out of which all things are made (possibly positive and negative electricity) combine and recombine in ever-increasing degrees of complexity to produce new and higher syntheses or "organisms." (In this view, which here agrees with Whitehead's philosophy, even atoms are organisms.) Our own development of this idea of the emergent evolution of progressively more intricate behavior-complexes is connected with the notion of a historically new or emergent dimension, a concept deliberately framed to provide a reconciliation of the relativity of motion (as Einstein treats it) and the absolutivity of motion.[2]

We recognize that the type of motion in which the science of mechanics is primarily interested is subject to all the principles of Einstein's theory of the relativity of motion. But growth and evolution (biological and psychological), types of motion (change) in which physics has hitherto not been interested, are *not* relative. This is a form of change to which present Einsteinian relativity does not apply. Motion as represented by the fourth co-ordinate of the space-time continuum is relative; but evolution, we insist, calls for a new dimension of time (a new form of temporal organization). This historically new dimension of growth is the $n + 1$ dimension, where "n" is any lower and earlier spatial dimension of "materiality" out of which this higher temporal organization of growth appears. Thus in our conception emergence adds a "degree of reality" to any "lower" plane of being.

Whenever we can refer to a system as a whole, with its spatial co-ordinates and its own "local" time, this time is transposable

[2] This idea was first expounded in my volume *Philosophy and the Concepts of Modern Science*, 1935, Chs. 1 and 8.

across the parts, as Professor Wheeler says.[3] If now this system (K_1) enters into dynamical interaction with another system (K_2), the two together may form a new system, and this system, so long as it is treated as a whole, will have its own (emergent) time transposable across the whole. *This new ("public") time is what we mean by the emergent dimension.* The "social" order that brings an emergent public time out of the "local" times of the individual constituents may even have its own "emergent mass," as George H. Mead puts it, and this, for us, represents the *field* of *gestalt* property of the family of subordinate systems. The significance of this idea is that it allows us to utilize the notion of an "absolute" time in what we call organismic or non-elementalistic situations. That is, in such cases we can determine whether one event is "simultaneous" with another when they can be "experienced" together by the "consciousness" of the "organism" that spans the local time of its own atomic (or "cellular") constituents. Aside from its importance for psychic phenomena (to be discussed later), it is interesting to note that this idea can be used to resolve the famous wave-particle difficulty in physics.

It is now generally known that in one set of experiments light acts *as if* it were a wave phenomenon, and yet in another set of experiments light clearly acts *as if* it were a corpuscular phenomenon. But what this situation really means, I think, is this: we must now recognize that the former separation in physics of the "observer" and the "observed"—in this case the "sink" and the "source" of radiation—is artificial; they play correlative roles. Light is a manifestation of a non-elementalistic or wholeness situation, and "particle" and "wave" concepts taken alone and in isolation give only part of the story. This is our reinterpretation of what Niels Bohr terms the principle of complementarity.[4]

At this point we pause for a moment to exhibit how this notion of "organic" time as an emergent co-ordinate associated with the unique (absolute) dimension of growth and evolution fits in with

[3] Cf. "Organismic Logic in the History of Science," by R. H. Wheeler, *Philosophy of Science*, 1936, Vol. 3, pp. 26–61.

[4] A statement of this reinterpretation and its significance for non-Aristotelian logic is given by the writer in an article on "Physics, Probability and Multi-valued Logic," to appear in a forthcoming article in the *Philosophical Review*. In this article we also try to show that our theory of the relativity of the observed to the observer (in a non-elementalistic situation) is in harmony with A. S. Eddington's theory of the conjugate role of the "thing" and its "comparison object." For the electron this is the universe as a whole.

our non-Aristotelian approach. The process of emergence, by means of which a thing changes (ceases to be what it was and becomes what it is), defies the laws of Aristotelian logic in the sense that it is unintelligible in terms of the traditional "laws" of thought. This unintelligibility in terms of Aristotelian habits of thinking is curiously reminiscent of the difficulties inherent in Zeno's paradoxes of motion. To see this, let us turn to the ancient Greeks for a moment.

In order to show that Zeno's paradoxes of motion are indeed related to the "laws" of traditional logic which Aristotle stabilized, let us note first of all that the "law of excluded middle" would be strictly applicable in a universe of discontinuous movement, but it does not hold in a temporally continuous process. This point is illustrated by the first premise of one of Zeno's arguments: "A thing must either move where it is or where it isn't." This is the law of *tertium non datur*, or excluded middle, that "A is either B or non-B," but not both. Zeno then continues: "But a thing cannot move where it is; neither can it move where it is not; therefore, motion is impossible!" Or putting the argument in symbolic form:

$$\begin{aligned} m &< w + w' \\ m &\nless w \\ m &\nless w' \\ \therefore\ m &= 0. \end{aligned}$$

Now, the difficulty here is that motion is precisely the process whereby a thing gets from where it is to where it wasn't: a third possibility which the law of excluded middle completely overlooks. In reality, therefore, $m < w + w' + (w \rightarrow w')$. Thus we agree with Brouwer that Aristotelian logic was derived from an abstraction from the mathematics of finite classes (and discontinuous processes), which was then universalized. Brouwer goes on to argue that the law of excluded middle is inapplicable to (cannot be shown to hold for) the domain of the transfinite. But the idea of infinity (along with that of continuity) underlies the whole modern mathematical analysis of motion (in differential calculus). And so Brouwer, like Hegel, must reject the modern handling of the problem of motion and change, and like Hegel, though for somewhat different reasons, he is forced to deny the applicability of one of the classical laws of thought of Aristotelian

logic. (Those versed in the technical details of philosophy will note here that Brouwer agrees with Bergson's view that continuity cannot be handled in the classical manner as a completed aggregate of points.) In our own view we try to bring these two views (of Hegel and Brouwer) together. We hold that the symbol ($w \rightarrow w'$) represents neither logical addition nor logical multiplication, nor any other operation of traditional or modern symbolic logic. This is what, in mathematics, introduces continuity and infinity into the analysis of motion and change, but for us this is what symbolizes the passage from the "is" to the "is not" of any changing or evolving entity. But especially the symbol ($\rightarrow$) designates the change or growth whereby the new time dimension emerges. *At this point the particle-aspect, associated with "identity," is lost in the emergence of a phenomenally new whole, with its own time system transposable across the parts.*

VI. An Objection Considered, and a Comparison

Of course the author is aware of the difficulties inherent in this theory. One objection to our conception arises in connection with our unorthodox use of the term "dimension." It will be pointed out that the use of the notion of higher dimensions (or hyperspace) in relativity physics, or the multi-dimensional phase space of wave mechanics, has no physical significance. These tricks of non-Euclidian geometry, it will be stated, imply nothing physical beyond three dimensions: the n-dimensional manifold is a dodge that must be interpreted to refer to (1) the number of *independent variables* of some physical system, or (2) the number of *degrees of freedom* of a configuration.

In replying to this point I can only say that the Euclidian-Newtonian assumption that the only "real" spatial dimensions of the physical world are the three co-ordinates of classical physics (that is, Cartesian co-ordinates) is a naïve view that came, perhaps, from the acceptance of the Pythagorean-Platonic-Aristotelian doctrine that "God geometrizes," and does so only in accordance with the scheme of Greek logic and mathematics. Now we should know better.[5] The detailed exposition of our

[5] It is interesting to note that in his latest attempt at a theory to link gravitation and electricity into one unified field theory, which will explain all physical happenings in one broad concept, Einstein has found it necessary to introduce a *fifth* dimension. Thus Einstein takes the idea of Professor Theodor Kaluza, who used the idea of a fifth dimension as a

broader definition of dimension as the emergent time-axis cannot be undertaken here. On another occasion I shall try to show how the current conception of the "spin" of the electron, which turns space into time and is connected with the principle of the indistinguishability of electrons and the "interchange energy" (or *resonance* between the elements) of newly forming aggregates, may find its place in this theory. This, however, is for the future. Now I am concerned to differentiate this view from a somewhat similar conception presented by a British investigator.

Those who are acquainted with the view of Mr. J. W. Dunne, first expounded in his book *An Experiment with Time* (1927), and more recently set forth in his *The Serial Universe*, may seem to detect a similarity between that view and the one here advocated. In the serial universe, time has a "regressive" character; for example, the time dimension for a three-dimensional observer is merely the direction in which his field of presentation is traveling in a four-dimensional manifold. Thus every time-traveling field of perception is contained within a field one dimension higher. The symbol $\sqrt{-1}$, by means of which orthodox relativity transforms time into space, in Mr. Dunne's view represents the rotation of an axis of time until its features coincide with those of the time of the next lowest geometrical map. Mr. Dunne believes that, in terms of this theory, he is able to show how the "perception" of events, for example, in dreams, might precede the actual happening of these events in our familiar physical world.

One serious objection to this view arises in connection with the postulation of an "infinite regress of time dimensions." This leads Mr. Dunne into the difficult concept of the "Observer at Infinity." In our own view, as in Mr. Dunne's, we accept the idea that in the physical application of multi-dimensional geometry time plays the role of the next highest dimension, but for us this is an "emergent," something historically new, which is generated by the aggregation of matter in the process of producing a whole that has associated with it a public time, binding the parts into a dynamic synthesis. Even though, in our theory, the number of such dimensions that may emerge may be unlimited, there is no "Ob-

---

mathematical notion without physical meaning, and ascribes physical reality to the fifth dimension. For us these additional dimensions beyond the bare space-time-matter level (as the levels of life, mind, social organism, etc.) are not given as antecedent realities through all "eternity," but they "emerge" as nature evolves.

server at Infinity" who can look back upon the serial order and resolve it into a spatial manifold of a lower order. For us the emergent time dimension is real; for Mr. Dunne it appears to be illusory.

VII. Organismic Time

As an illustration of the macroscopic (public) time transposable across the microscopic parts and binding the source and sink of radiation together, we may cite the example given by C. G. Darwin in his book *The New Conceptions of Matter* (1935). In connection with his exposition of quantum mechanics,[6] Darwin refers to the experiment in which it appears that electrons will not pass through one small hole in a shutter unless another hole is made close beside it. (The statement of the details of this experiment is much clearer in J. H. Jeans's *The New Background of Science* (1933).[7]) In Darwin's interpretation "the only possible way of explaining this is to say that each of the electrons knows all about both holes, or has gone through *both* holes at the same time, because only thus could we get the cancelling effect characteristic of interference." But only five pages later[8] in the same volume Darwin points out that Einstein, in upsetting the idea of absolute time in nature, showed experimentally that "in fact it is really impossible to determine whether two events in different places occur at the same instant." This seems to contradict the earlier statement. But the contradiction is only apparent.

In the first case (the electrons going through both holes simultaneously) the result is a part of one total experiment (or wholeness-situation), and no problem of relativity of time-measurements is involved. That is, the various parts of the instrumental set-up are surveyed as parts of one common public time; whereas in time-measurements across two independent co-ordinate systems (frames of reference) there is no measure of absolute simultaneity, *unless both systems become part of a more inclusive system which in turn is treated as a whole.* The transition in organisms from intra-cellular to cellular, or from cellular to inter-cellular synthesis, is an illustration of this gestalt (field) property in which the "local" times of the atomic constituents are incorporated into a public time trans-

[6] *Op. cit.*, p. 90.
[7] P. 159.
[8] P. 95.

posable across the parts. Later on we shall indicate the analogous linkage of the "sender" and "receiver" that occurs when extra-sensory processes act "across" space and time to unite the mind and its object through what we shall term a "psychic ether."

VIII. Space, Time, and Extra-Sensory Perception

The reader may well wonder what all this has to do with ESP and our new philosophy of nature. In replying to this query let us first go back for a moment. We have already made the point that the new world picture of science is modifying our conceptions of what is "possible" in nature. Following this up in more detail, we now urge that the advent of non-Aristotelian principles of reasoning teaches us that (1) certain things (or events), such as ESP phenomena, may appear possible in nature when our minds are freed from slavery to traditional habits of thought, and (2) certain phenomena of a "psychic" nature may become "understandable" and even more easily manifested when human minds begin to function uniformly on the coming non-Aristotelian level of orientation.

Next we point out that the notions of telepathy and clairvoyance (both of which involve communication at a distance, appearing to violate the properties of familiar space and time) can be made rational (if they can be made intelligible at all) only through the notion of an "absolute" time. For example, if a person receives telepathic messages about events that happen at some distant part of the world at the same instant at which they happen, this means that somehow distant events can be "simultaneous" and can be experienced as such. "Premonitions" and "precognition" probably also presuppose an ability to place events in an absolute time scale.

After the writer formulated the foregoing theory of emergent organismic time, it was then discovered that at least one other author had speculated along similar lines, and I quote the following passage of Professor A. P. Ushenko's volume, *The Philosophy of Relativity*,[9] as indicative of this parallel conception:

> The assertion that there is no physical interaction between distant events must not shut the door on the possibility of metaphysical instantaneous transactions at a distance. Even the ordinary functions within a

[9] London, 1937; p. 49.

single organism, the organic relationships, might easily happen to be on a level which is to a certain extent free from purely physical restrictions. For it seems to be a fact that the whole volume of one's body may be sensed at the same instant; and one may speculate whether this togetherness of all parts within an organism is capable of extension to its environment, as, for example, when a fencer learns to feel with the tip of his rapier. Also there are believers in telepathy and in the instantaneous propagation of emotional influences. All such opinions could be allowed for, if one conceives the world as a hierarchy of ontological levels, of which the physical level gives the basic framework of temporally unrelated events (contemporaries) as a field of potentiality for their various interrelations on the higher levels, the organic transactions being, perhaps, the simplest mode of such interrelation, beyond which there may be other as yet unexplored modes. This is a fertile source for metaphysical conjectures.

The main difference between the above view as stated by Dr. Ushenko and my own theory lies in the fact that for me there is (as in the experiment cited by Darwin) room even in physics for a dynamic unity of source and sink which makes possible a public time transposable across the parts of the physical situation.

It is now clear to the reader that our own theory of extra-sensory perception involves the notion of an organismic situation binding the members of the human race together. In the present view we are forced to assume that the "local" time of each human individual is now, through a process of "mutual aggregation" (to borrow a phrase from Josiah Royce), beginning to cohere into such a group time. Telepathy, clairvoyance, and the like may turn out to be indications of this dynamic unity whereby a new social whole is emerging. But what is this emerging organism which is producing a public time as a new time-axis? And how shall we understand and explain such a remarkable event in biological evolution? Before attempting to answer these questions, which takes us into the field of biology, let us restate the physical basis of our theory.

We have argued that the advances in contemporary physical science serve to make us more open-minded about possibilities in the field of extra-sensory perception. In time the recent revolutions in physics will help create a new type of theory in psychology. Already, under the influence of gestalt theory, based on

field physics, modern psychology is being led step by step closer to the idea of consciousness as a pulsating electromagnetic field in and around the brain and the central nervous system. This idea provides a mechanism for the instantaneousness and richness of content of conscious experience and helps us to understand some of the newly discovered facts of electroencephalograms (cortical rhythms due to changes of electrical potential in the brain). It may also help us to explain the evolutionary intensification of consciousness previously discussed. In the human brain the movement of liquid ions to and from colloid interfaces cannot give a sufficient degree of speed and flexibility for psychic life.

But even this modification of traditional brain physiology is not sufficient to explain Rhine's results. For if consciousness were some form of familiar physical radiation, it would obey the usual inverse-square law. But in Rhine's experiments on distance-telepathy—as we have already observed—the results do not fall off with increase of distance. This ability of mind to triumph over what the older physics would regard as the normal limitations of time and space is one of the most interesting features of Rhine's work. Actually the "new" physics also has followed this tendency to transcend the older limiting conditions of nature, and this is true whether one is thinking in terms of relativity theory or of quantum theory, in either their earlier or later forms. Let us consider this for a moment in more detail, before passing on to an examination of the biological-social organism.

Turning first to relativity theory, it is very interesting to note that although Einstein's theory states that the velocity of any form of radiation cannot exceed the limiting velocity of light, this does not exclude the idea (presented in the de Broglie-Schrödinger theory) that *certain kinds of group waves can travel at any velocity*, and this does not contradict the teaching of relativity physics concerning the constancy of the velocity of light. In the more recent theorizing of Dirac there is another departure from the ordinary ideas of relativity, in the sense that in the interior of the electron it is possible for a signal to be transmitted faster than light. Here there is a region of failure of the elementary properties of space-time. Now since in the physical world the amount of space to be traversed, or involved in the transmission of influences, is inversely proportional to the velocity of transmission of such influences, we can say that space progressively loses its

reality as a limiting condition in nature as we increase the velocity. In the above case, in which a source and sink of radiation are linked together into a dynamic whole, we can say that the space-time interval of separation is zero, or we can introduce the notion of "virtual contact," or we can try to cover the situation by saying that the influence in its transmission approaches an "infinite velocity." But in our own language we would say that this is a wholeness-situation, not explicable in elementalistic-atomistic terms.

It is interesting to note that in quantum phenomena similar problems arise. The original photoelectric effect is still with us: light of a certain *frequency* will knock out an electron from an atom, and this is quite independent of the *intensity* of the light; in this case it makes no difference how far distant the atom is from the source of the radiation. In a sense this is similar to distance-telepathy results, except that the transmission of the symbols on Dr. Rhine's cards is a more complicated affair. This "mystery" of physics (the photoelectric effect) was one of the origins of quantum theory, which later was transformed into "wave mechanics." The latest speculations in this field commit the physicist to the doctrine (altogether inexplicable on the older Newtonian-particle physics) that when a "particle" passes through a slit it may be considered as a group of waves, and the frequency of each harmonic train in the group is changed by the modulation due to the shutter of the slit.

In this fashion we see that no matter how we "take" our modern physics, it still remains true that mutual influences and transactions are possible which the older physics, with its antiquated ideas of "space," "time," and "matter," would have been forced to declare impossible. About the only outstanding scientist who realizes the significance of these new physical ideas for psychology and has the courage to declare it is Professor J. B. S. Haldane. In his recent book, *The Marxist Philosophy and the Sciences* (1939), Professor Haldane states:[10] "I do not see why a dialectical materialist should reject *a priori* the possibility of such alleged phenomena as telepathy and clairvoyance . . . if their occurrence should be proved, I do not think this would disprove materialism, or even revolutionize science; though it would open up an im-

[10] P. 169.

portant new field, and very probably facilitate the study of the human mind as a natural phenomenon." Haldane is led to this supposition as a result of considering the discovery that elementary particles will leak through a "potential barrier" that they could never cross if classical physics were true. As Haldane says,[11] "the fact is that, whether or not we take the wave system as a reality, the electron is influenced by surrounding objects in a manner not contemplated by physics up till the last twelve years."

Surely it is something of a triumph that the old dilemma of "action at a distance" *versus* "action by contact" is now solved in a non-elementalistic logic. This "organismic" situation is unintelligible in a completely "atomistic" view of nature, and it provides the physical homologue for such "short-circuiting" processes as we shall later assume to occur in psychical processes. Before leaving this matter, let us once again emphasize that on our theory space and time are not antecedent realities (like vessels or containers) into which things are put. They emerge as simpler entities of a lower order interact to produce more complex aggregates. On the human level the space and time of a psychic continuum (or a psychic ether) are conditions for mental interactions, as we shall now try to show.

IX. The World Sensorium

Just as in previous pages I have made use of the results of Dr. Rhine, so now I am going to incorporate into our new world religion the views of another investigator, Dr. C. Hilton Rice, whose approach to the study of man is from the side of medicine.[12] Dr. Rice's central insight into the approaching unity of mankind is based on the fundamental thesis that *the organic kingdom as a whole is literally and in fact an organism, with the human race taking the place of the developing nervous system (the neuroblasts) of this organism.* That is, the organic kingdom as a whole is the body of a single embryonic and developing being that is feeding upon the substance of a gigantic egg, the earth. According to this picture of the world-organism the plant and animal kingdoms form (function-

[11] P. 168.

[12] The untimely death of Dr. Rice in 1937 occurred before he could publish his treatise on *The Visible Organism,* though an abstract of the theory appeared in *Psyche* (London), January, 1929. Dr. Rice was one of Dr. Rhine's best subjects in ESP research, and some of his results edited by Dr. J. G. Pratt, were presented in the *Journal of Parapsychology,* December, 1937.

ally) the entoderm and ectoderm of a super-organism, and the human race serves as the nervous system of the embryo. This evolving system of life is operated by the energy from the sun, which fabricates the essential substances that the earth-yolk feeds to its embryo. As we have said, the nervous system of this super-organism consists of the sum total of the nervous systems, with the human race functioning as the cerebrum, the whole held together, not by "material" continuity as in the case of the cellular structures of the component parts, but by the "herd instinct," the "group mind," etc.

The way in which this sun-planet-organism hookup is maintained, so that the outer layer of air and the inner layer of rock enclose between them a layer of water, through which the rock layer protrudes to form continents and islands, is a matter for science to investigate. For Dr. Rice the most interesting phase of this developing embryonic being is the manner in which a great composite mind is beginning to dawn and reveal its form and potentialities in the social consciousness. Thus man's deep religious sense finds its confirmation in the coming into existence of a being in whose image man fancies he has been created. And just as the unborn babe cannot know and communicate with its parents until it has developed the ears to hear and the eyes to see, so this huge embryo, the earth-organism, cannot know itself until it has developed organs of sight and hearing, faint anticipations of which we now see in radio and radio-vision. These are the precursors of the extra-sensory perception of Humanity, the brain of the embryonic earth-organism.

In his theory of extra-sensory perception Dr. Rice puts forth the suggestion that our sense centers are two-way mechanisms that register impressions both from the sense organs and from the cortex. How, he asks, does a child in night terrors see objects that have no "reality"? His wide, staring eyes show plainly that the object is registered in the sight center and projected outward by a reversal of the mechanism of distance reception. Apparently a part of the cortex (in the sleeping state) is sending impulses to the cells of the visual center and these impulses are transmuted into images of things "seen." In what is known as "eidetic imagery" the phenomenon occurs in the waking state. In short, it looks to Dr. Rice very much as though the visual center may respond to both sensory and non-sensory stimuli, the one type

coming from without and the other from "within." In extra-sensory perception the cortical cells may act as receptors and transmit impulses to be interpreted visually.

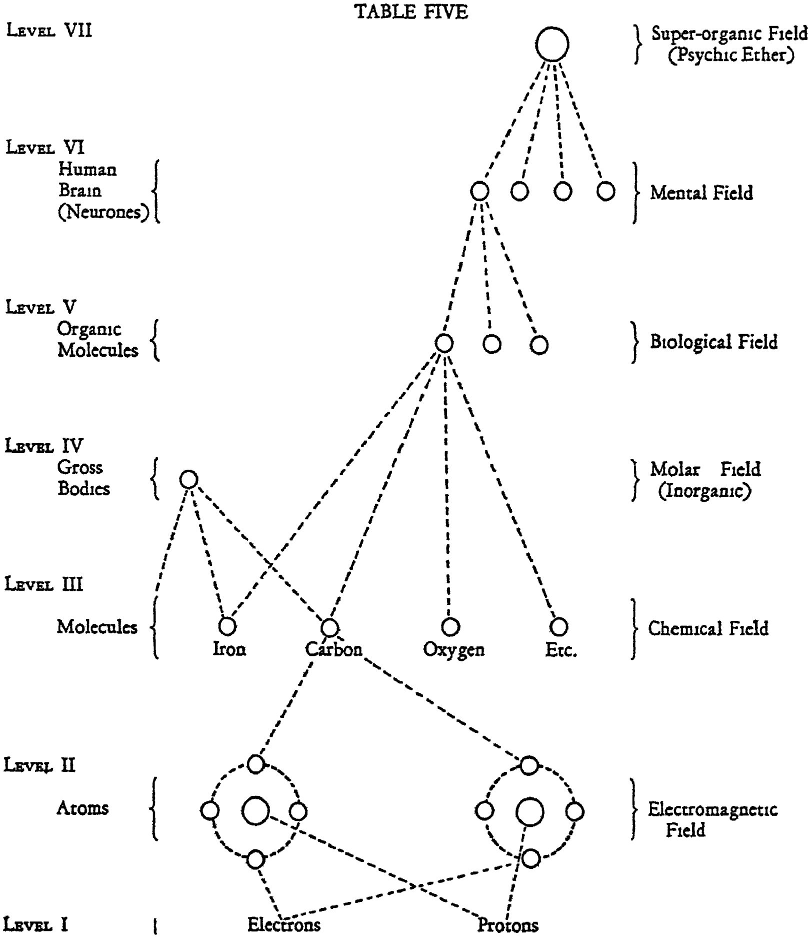
Such is the reasoning of Dr. Rice. Now let me integrate this with some speculations of my own.

The "physical" basis of the new psychic unity of mankind, if it is ever to be attained and understood, must be pictured first of all in its most general terms. As we have indicated in *Philosophy and the Concepts of Modern Science* (Chapter VII), we make the general assumption that the activity of any entity of nature (electron, atom, cell, organism) always takes place within a field or environment. The entity itself is a behavioral unity of its constituents, and any entity, plus its field, yields an entity of a higher order. This field, or "ether," is a result of a compounding of the microscopic fields to produce a macroscopic field. Thus the synthesis of residual atomic fields produces a molecular field, and the compounding of molecular fields produces a molar field. As we have already noted, the explanation of telepathy and clairvoyance seems to demand some sort of psychic ether or continuum, and this, we have surmised, may arise out of a compounding of biological (cortical) fields to produce a super-organic field. Thus, just as a molecular field is created by the synthesis of the electromagnetic fields of the atomic constituents, so the mental fields of each human brain, under appropriate conditions, might be responsible for the creation of a psychic ether.

The diagram we are giving may help to visualize the situation, but the foregoing argument is so fundamental that we restate it. We hold that just as each synapse levies a minute toll on each nerve process to build up a psychic field that forms the basis of the "consciousness" of each individual human being, so each human consciousness makes its contribution to a collective consciousness, a psychic continuum or ether that is the medium of interaction in telepathic and clairvoyant rapport. Just as molecular fields utilize (and are created out of) the residual electromagnetic fields (or unsaturated bonds) of atoms, so the residual fields of human brain fields combine to produce a super-individual field. But even though we suppose that in this fashion a collective human consciousness is being born, the theory that the human race constitutes the neuroblasts (embryonic nerve cells) of the developing earth-organism places restrictions upon the theory of emergent evolution.

In other words, the form of humanity already exists as the potential framework guiding the whole course of biological evolution, random and haphazard as that may appear to be. The potential form of humanity acts as a morphogenetic field of force controlling neuroblasts of the embryonic organism so that the "mutations" behind man's evolving psychic faculties are not due completely to "chance." The emerging world-organism helps to create the inter-personal continuity that its gradual synthesis heralds and foreshadows.

TABLE FIVE



X. Some Unsolved Problems

It is true that this view still requires further development. Many questions can be raised that are difficult to answer. We have already discussed the physicist's possible difficulty with our conception of "dimensionality." And here are some additional problems: Why has the existence of a medium such as we have postulated—a psychic ether—never been experimentally demonstrated through the use of physical apparatus? Why are those who are gifted with ESP so relatively rare in our population? And why do these psychic powers appear to run in families? And why are ESP faculties so flickering and fitful, so readily fatigued, and so uncertain in manifestation? These and other interesting questions still remain to be answered. I cannot reply to all these questions—even if I knew the answers!—but we can throw out a few suggestions.

With reference to the first question, we may suppose that, aside from the possibility that the psychic medium or continuum may not be susceptible of investigation by physical means, negative results may be due to the fact that the psychic ether is still in the process of being created. Or again, failure to detect the presence of a "psychic ether" might be explained on the theory that the phenomena of a higher dimension cannot be trapped in the instruments of a lower dimension. In connection with this suggestion, we may point out that our theory of the emergent dimension as a new form of spatio-temporal organization results in a theory of an "ether" or field not subject to investigation by such experiments as the famous Michelson-Morley experiment. This experiment was performed to decide whether or not the luminiferous ether was dragged along by the earth in its onward motion through space. The fact that all experiments on the motion of material bodies relative to the ether have led to negative results (except the controversial results of Dayton C. Miller) does not discredit the notion of a field or ether as we employ it. The Michelson-Morley experiment was performed on and about the earth only, and no other body played a part, hence it might be argued that the result is what should have been expected: the earth is at rest relative to itself; while relative to the sun the earth moves and relative to the earth the sun moves. In so far as both the sun and the earth (plus the other bodies of our solar system) enter into a dynamical configuration which makes it possible to treat the sun-planet-system

as a whole, there is a "cosmic ether," but this cannot be detected by experiments *within* the system.

Returning to the suggestion that a psychic continuum for the human race is still in the process of creation, we surmise that perhaps a true social mind is being generated by the gradual synthesis of a super-mental field, the physical basis of which is the sum total of all nervous systems. If it is true, as Sir James H. Jeans has imagined, that each individual consciousness is a brain cell in the universal mind, then the present intercommunication between disparate areas *within* the individual human brain will be paralleled in the world-mind by direct communication *between* human minds.

The remaining questions cannot be answered satisfactorily, but it does appear that there is some hereditary basis for the presence of psychic faculties in certain individuals. This may be due to a mutation which, once it occurs, is biologically established and continues to reappear in subsequent generations so long as they are not eliminated in the "struggle for existence." This aptitude may rest upon some change within the brain or in the body generally. Since the faculty of ESP seems to be related to unusual powers of "concentration" (or possibly "integration," accompanied by a corresponding detachment so far as the immediate environment—"distracting stimuli"—is concerned), this may arise out of some change in cerebral chemistry that permits an unusual type of orientation of molecules at the biological interfaces which give rise to electromotive forces (bioelectric potentials). In our volume, previously referred to, we have pointed out that potassium, the only (spontaneously) radioactive substance in the body, has the power to facilitate such molecular orientation, and we have proposed that in this fact may be found one clue to the interaction of mental fields and biochemical processes in the brain.

A final possibility which we must mention is that perhaps the explanation of these unusual powers will be found in the new ideas which chemists are taking over from wave mechanics to explain "chemical affinity." The notions of "resonance energy," "electron interchange," the "spin" of atomic particles, and the like, we are bound to hear much of in the future.

These are a few of the suggestions that can be brought forth to explain the body of facts which investigators of things psychic have turned up. They all indicate that it is at least possible to

conceive of some sort of "mechanism" whereby the space-time intervals that normally isolate individuals from each other may be overcome. If we are indeed moving toward the creation of a world-mind in which direct inter-personal continuity is established, we get a new insight into human motivation. Thus the normal human craving for fellowship (the "herd instinct") appears not merely as a *vis a tergo*, a psychic regression to the group mind of primitive man; it is also a *vis a fronté*, a striving toward a higher unity—the next emergent level of nature.

If all this be true, as time goes on the "law of identity" will become even less satisfactory as a description of human individuality. And thus we are confirmed in our conclusion that extra-sensory perception, defying the time-honored laws of Aristotelian logic in their scientific applications, is but a feeble and uncertain intimation of psychic powers yet to be evolved and perhaps eventually to become universal in the human species. *Evolution is not yet through with the human organism, for still higher functions remain to be developed.* Humanity thus appears as a god in embryo, a developing being with the psychic powers—omniscience and omnipresence—which man has hitherto assigned to his God. Perhaps man will eventually find that he is made in the image of God because God is being made in the image of Humanity.

XI. Evolution and the New Humanism

This doctrine that man is a potential god is of course one form of humanism. As Charles Francis Potter has stated, when the radical nature of humanism is recognized, its truly revolutionary possibilities will become manifest. This is the only non-supernaturalistic religion that can recapture the moral idealism and emotional drive of the ancient and obsolete forms of religious expression.[13] The way in which the direct realization of the unity of mankind may help to create a new technique of political and economic living is a matter beyond the scope of the present volume. But if the picture I have tried to paint for you is correct in its main features,[14] you may be sure that a novel type of social

[13] For a statement of Dr. Potter's views see his book *Beyond the Senses*, 1939.

[14] The latest summary of the status of ESP research is contained in the volume *Extra-Sensory Perception After Sixty Years*, by Dr. Rhine and his coworkers, 1940. The faith of these men in the validity of their conclusions has not been shaken as a result of the deluge of criticism which has descended upon them. These criticisms are thoroughly investigated in this new book.

science is on its way to reality. Part of that new science of society will involve the use of a new type of logic, such perhaps as we have tried to formulate in Part I. In trying to round out the more general picture of biological evolution we now, in the following chapter, pass on to a consideration of the non-Aristotelian theory of evolution.

CHAPTER TWENTY-ONE

COSMECOLOGY: A NON-ARISTOTELIAN THEORY OF EVOLUTION[1]

The book of Nature is a fine and large tapestry rolled up, which we are not able to see all at once, but must be content to wait for the discovery of its beauty and symmetry, little by little, as it gradually comes to be more unfolded or displayed.

—Robert Boyle

I. Cosmic and Terrestrial Dynamics

In his interesting book, *Earth, Radio and the Stars*, Professor Harlan T. Stetson points out that the solution of the problems concerning the earth and its inhabitants in the cosmic scheme of things bids fair to introduce a new synthetic science, which he designates as "cosmecology." The argument is that as during past generations science has passed through a highly analytic age, so it is likely that in generations to come we shall pass into a synthetic age in which the results of the highly specialized fields of science will be brought together into the solution of problems too far-reaching to be solved by any court of specialists. Problems of the nature Professor Stetson has in mind concern the geologist, the physicist, the meteorologist, the radio engineer, the astronomer, and even the biologist and the economist. In the present chapter we propose to carry still further the consideration of a problem that illustrates the kind of situation Stetson has in mind—the theory of biological evolution. I am returning to this much discussed problem of evolution because the conception outlined in the preceding chapters requires it, and because new light from various sources indicates that Darwin's theory was incomplete—so much so that the true understanding of the evolutionary process calls for precisely the kind of synthesis from all fields of science that Stetson has in mind.

[1] The present chapter was first published in the *Journal of Heredity*, 1937, Vol. 28, and with some changes is reproduced by permission of the editor.

As is generally known, the four main considerations that Darwin's theory of the "origin of species" introduced to explain biological evolution are as follows: (1) the fact of heredity; (2) the doctrine of variations, minute and insensible, continuously appearing in the offspring; (3) the struggle for existence, due to overpopulation in terms of available food supply; and (4) the survival of the fit. The neo-Darwinians still hold that this theory of evolution is correct in its main features, and they hold that the only emendations necessary lie in getting a clearer picture of the nature of the first two factors, heredity and variation.

Without ourselves subscribing to the Darwinian theory of evolution, we note that present-day genetics is concerned primarily with (1) the mechanism of heredity, about which Darwin could only speculate, since genes and chromosomes were unknown in his age; and (2) the cause or causes of biological variations, or better, *mutations*, as De Vries has shown. Little progress was made in connection with the problem of the origin of biological mutations until the important work of Muller on the effect of X-rays in producing those changes that must underlie the production of new mutants (varieties).

In recent years a considerable number of investigations have been concerned with the possible influences of X-rays, gamma rays from radioactive substances in the earth, and the like, upon plant and animal forms subject to irradiation by such frequencies. The fact that in experimental studies the vast majority of such induced variations is lethal does not detract from the importance of the discovery that the *rate* of biological change is greatly speeded up. Following Muller's work, it was only to be expected that the idea would be put forth that "cosmic rays" also play a role, not only in the production of new varieties of plants and animals, but also in the origin of life itself and its malformations in neoplastic growths.

II. Radio-Mutations

The new "radiational" theory of the cause of mutations is experimentally well-grounded and theoretically reasonable. Modern genetics indicates that the ultimate units of life are very small. It has even been suggested that the gene is the ultimate living unit.[2]

[2] Recently Professor Richard Goldschmidt has attacked the "gene" theory in favor of a theory of "physiological genetics." So far as the present theory goes, it makes no difference whether the genes or chromosomes are taken as the ultimate units of heredity.

However that may be, certain very small units (either genes or chromosomes) certainly determine the details of inheritance. If, therefore—as R. S. Lillie suggests—a single extreme localized oscillation of a particle within a system may form the occasion for a process involving the whole system, we are brought face to face with the supposition that fluctuations in the Brownian movements in the ultimate units of heredity may lie at the basis of mutations. Perhaps, then, radiation—even as little as a single quantum of energy—is sufficient to activate chemically and induce the extreme fluctuation responsible for the mutation. Such appears to be the status of the matter at the present time.

The curious thing in all this is that in the course of evolution nature apparently "loafs along" for a time and then suddenly "gets busy" and produces results. The only alternatives available to explain this are: (1) that the cause of mutations is some periodic (fluctuating) source of activation, or (2) that the cause is constant in amount or intensity (or non-periodic) and that some sort of relaxation-oscillation, or accumulation to a critical point, is involved. Since, however, mutations experimentally produced do not apparently show any such relaxation-oscillation effect, we return to the first alternative.

If cosmic rays are causally connected with the origin of species, there must be some periodicity in the reception (and possibly also the production) of such "rays" which corresponds to the alternate periods of "rest" and "activity" exhibited in biological advance. In seeking for the cause of such periodicity, it is necessary to keep in mind one other difficulty that must be met before we can claim to possess a theory adequate to all the facts. The difficulty mentioned arises from the fact that the quantitative values required to produce mutants experimentally do not coincide with those of the natural radiations that are actually now available at the surface of the earth, on which our present population of plants and animals lives. These two requirements of a cosmic-ray theory of the origin of mutations—namely, of temporal periodicity and variability in amount—are lumped together because in the theory here proposed an effort is made to take care of both requirements at the same time.

III. The Universe-Clock

In reflection about this matter, the first suggestion that arises is this: Since within the range of experiments reported during the

period of time that physical scientists have been interested in cosmic rays (mainly since the World War) no suitable temporal periodicity in their reception has been discovered, may we not make this supposition: *Is there not some sort of periodicity in the streaming of cosmic rays to the earth, which periodicity lies OUTSIDE the temporal limits of such recorded experiments?* If so, such a cycle might be responsible for the major types of living forms, and these would appear on those occasions when cosmic rays were at the flood tide. This hypothesis creates the problem of finding some cause for the supposed temporal periodicity and variability in intensity. In first thought about this matter the only cyclical variation that appeared to me to possess the necessary long time-scale was the revolution of the entire Milky Way around its center. Our galaxy, a watchlike disk that carries our own earth and solar system along with it, travels about 200 miles per second and completes a revolution every 300,000,000 years. The number of cosmic "days" necessary to complete biological evolution (up to date) might then be calculated as follows: If the age of our own earth is set at 1,500,000,000 years (by the radioactive clock of the geologist), the number of major "diurnal" variations of cosmic rays would be the age of the earth (one and one-half billion years) divided by 300,000,000 years, and the quotient thus obtained turns out to be *five*. This theory of the periodicity of the earth's reception of cosmic rays as coming from beyond (or possibly even from within) the Milky Way and entering into the region of our solar system at certain privileged positions as our galaxy revolves around its center was at first very attractive to me, especially when it was recalled that there are *five* major geologic eras, each correlated with the emergence of its own type of living form. These eras are as follows: (1) Archeozoic—unicellular organisms; (2) Proterozoic— invertebrates; (3) Paleozoic—fish; (4) Mesozoic—birds, reptiles, and primitive mammals; (5) Cenozoic—higher mammals and primates.[3]

There were two major difficulties with this theory in its original form—aside from the considerable overlapping of the above types of living forms, which was to be expected anyway. In the first place, if the periodicity in the reception of cosmic rays is corre-

[3] It is true that some estimates of the earth's age place it at two and one-half billion years, but then some estimates of the velocity of the earth's motion through space place it at closer to 300 miles per second. When the final results are in, it may still be true that the *ratio* between the two figures remains as given.

lated with the revolution of our solar system around the center of our entire galaxy, the time of each maximum increase presumably ought to be the same, when as a matter of fact the five geologic eras are not equal in duration and spacing; and, secondly, there does not appear to be any reason why a periodic 300,000,000-year "day" should make any difference in the sending and receiving of an extra heavy dose of cosmic rays. Fortunately at this time my attention was called to an investigation by an English theorist, Dr. H. Hanshaw Thomas.[4] This investigator points out that the ionization due to cosmic rays falls off rapidly as these rays pass through the earth's atmosphere, and that if biological nuclear changes and mutations can be produced by cosmic radiation they will vary with altitude. Dr. Thomas therefore sought for a correlation between the variations of species and the intensity of cosmic radiation at different heights above sea level. He finds some evidence of the origin of new species of plants at higher mountain altitudes, where the cosmic ray "showers" and "bursts" are greatest and therefore most likely to make direct hits on chromosomes. The value of this suggestion is that it lends support to the cosmic-ray theory of the origin of mutations, but its defect from our point of view is that it does not provide for the periodicity in their reception or intensity which we have postulated.

In order to provide a possible explanation of this supposed periodicity, let us momentarily disregard our earlier supposition that this periodicity is due either to a variable source of emission or to the rotation of our galaxy, which periodically brings the earth (and the solar system) into some hypothetically privileged position with respect to some constant and possibly extra-galactic source of cosmic rays. Let us rather assume now that cosmic rays stream uniformly through the earth's cosmic environment. Then we must look for some other explanation of the assumed periodicity. The suggestion next arises that perhaps the cosmic-ray showers and bursts mentioned by Dr. Thomas are raised and lowered above the surface of the earth somewhat like a stream of particles from a machine gun sweeping the horizon, except that the "horizon" of the cosmic rays is the entire earth's atmosphere. If, indeed, as the recent work of Carl D. Anderson and Seth H.

[4] See his article on "Cosmic Rays and the Origin of Species," *Nature*, 1936, Vol. 137, pp. 51–53 and 97–98.

Neddermeyer[5] on the top of Pike's Peak shows, cosmic rays are capable of smashing up atoms and molecules and liberating highly penetrating neutrons, why shouldn't cosmic rays, or the secondary radiations in the form of high-energy particles which they liberate, be able to reach the genes and bring about nuclear changes in the organism no less effectively than in the hearts of atoms?

IV. The Ion-Blanket

But what is the protective armor plate that *to some extent* prohibits the full measure of cosmic rays from reaching the earth and its inhabitants? The only "blanket" that does in fact vary its height periodically is the ionosphere. It is now generally known that there is an extensive region of ionization above the earth's stratosphere. This region of ionization is irregular in height, varying from 80 kilometers to several hundred kilometers above the earth's atmosphere, though it is believed that the 100-kilometer level constitutes the region of maximum ionization. This ionosphere, the next level above the stratosphere, is frequently referred to as the Kennelly-Heaviside layer, and is responsible for the reflection of radio waves back to the earth's surface. Now we propose to introduce the hypothesis that this layer not only makes possible long-distance radio transmission, but is also concerned with the evolution of life here on our planet. First, however, we need to point out that the cause of the ionization of the Kennelly-Heaviside layer is to be found largely in the ultraviolet light from the sun and that during the day the effect of solar radiation is to increase the ionization and lower the layer, while at night, when the sun's radiation on one-half of the planet disappears, there is an elevation of the Kennelly-Heaviside layer. The improved reception over the radio at night is related to this fact, but this does not concern us now.

Now we come to the next stage in the development of the radiational theory of the origin of species.

Since it is true that the highest mountains are about 8,000 meters high, while the ionosphere is about 100 kilometers high, it is necessary to suppose that some unusual source of ionization is required to bring about an effective lowering of the Kennelly-Heaviside layer so that the cosmic rays may shower their atmos-

[5] Cf. *Physical Review*, August 1936.

pheric shrapnel over the now exposed plant and animal species. The only cause for this must be found in the sun's influence. Here we recall that while the normal ultraviolet portion of the sun's radiation is largely responsible for the principal ionization, there is also an increase in ionization whenever there is an increase in sunspot activity. There is no doubt that the sunspot cycle directly influences the terrestrial atmospheric ionization and also produces changes in the magnetic field of the earth. It is also probable that streams of particles from the sun act as ionizing agents, and thus electrons, positrons, and perhaps the recently discovered neutrons, emanating from the electrically disturbed regions of the sunspots, have their effects in the intensity of the earth's magnetism; but since ionizing agents of a corpuscular nature will be compelled to follow a curved path toward the polar regions as they approach the earth (because of the influence of the earth's magnetic field acting on such corpuscles), such particles cannot have any effect in producing mutations in living forms around the earth's equatorial regions, except perhaps indirectly.

On the present theory, then, we suppose that at least a certain unspecified portion of the cosmic rays are photons, uncharged electrically, which are striking the earth's atmosphere from all directions and breaking up the neutral molecules of the gases of the atmosphere (oxygen and nitrogen) and thus helping to ionize the earth's atmosphere. *But the height of the ionized layer is for the most part regulated by the mechanism of the sun, which therefore acts as a kind of pacemaker for biological evolution.* With the increase in sunspots the blanket, which normally protects life from too much irradiation by cosmic rays and the sun's ultraviolet light, is lowered to such an extent that species of plants and animals on mountain tops are showered with penetrating radiation and the secondary "bursts" which are produced, and thus the earth at these times takes on the characteristics of an experimental laboratory for the productions of mutations. The direct hits on the chromosomes induce the biological changes which ultimately are the origin of new species, and thus evolution is speeded up. Following this, there must be a raising of the curtain to its "normal" level, and organic nature loafs along again until there is a repetition of the process. It is true that this raising and lowering of the ionized layer is correlated with some increase and decrease

of atmospheric pressure (normally about 15 pounds per square inch), and this might seem incompatible with the continuance of life of land animals, but we are here dealing with differences in degree and not absolute changes, so that the limits of variability of the earth's atmospheric environment and the range of adaptability of organisms may well overlap in this case.

We realize, of course, that this assumed periodic disturbance on or in the sun is itself still unexplained. The explanation may lie within the internal condition of the sun, or in the wider cosmic scheme of things, or both. It might be supposed that if the sun were a variable star, it would pulse according to its own rhythm, but this supposition must be rejected, if for no other reason than that it is improbable that this rhythm would also be the tempo of evolutionary change. Looking to the wider scheme of things, it is interesting to note that Fernando Sanford[6] presents evidence indicating that sunspots are related to the configurations of the planets. If this idea is verified, it follows that the dynamics of the solar-system-as-a-whole must be taken into account if we desire a complete understanding of biological evolution. Moreover, in the scheme of cosmobiology we have not completely ruled out the possibility that the dynamics of the entire galaxy, our own rotating Milky Way, may still be actively involved in the periodicity of cosmic-ray phenomena. At the present time the only suggestion along this line that comes to me is that the increase of cosmic rays might be due to the position of our own galaxy in some super-galaxy. The moving in and out of our galaxy with reference to some focal center of a super-galactic swirl might affect the radiant energy received. Perhaps the use of our new 200-inch eye, the Mt. Palomar telescope, will help us to answer that question.

V. Some Philosophical Implications

And now we consider the philosophical implications of this theory. Here we should remember that a considerable amount of caution is advisable, for the history of philosophy is largely a record of unverified and unverifiable implications.

At the very outset it should be clear that the statement we here assert, that such a theory as we have just outlined gives us a new

[6] Cf. "Influence of Planetary Configurations upon the Frequency of Visible Sun Spots," *Smithsonian Miscellaneous Collections*, 1936, Vol. 95, No. 11.

insight into the unity of nature, proves very little so far as the truth or falsity of traditional types of philosophy is concerned. It may well be, as we have intimated in previous chapters, that life is not an "accident" in the affairs of the cosmos, a mere matter of "chance." The theory certainly indicates that there is what L. J. Henderson calls a "fitness of the environment" for the origin and evolution of living systems here on earth. And yet this principle might be consistent with several different types of philosophical systems. From the present point of view it appears that the time has come to abandon the stereotyped labels of the various schools and movements of philosophy. We hold that it is a mistake for modern thought to force itself into the traditional molds, for this today stultifies originality and degrades thinking. We need to rise above the oppositions of "materialism" *versus* "idealism," and the like. This, then, is our first suggested implication.

A second implication of a new insight into the unity of nature, such as is illustrated by the sun-planet-organism hookup we have imagined, is that the famous and time-honored "law of identity" gives us only one-half of nature's story. If, as we have suggested, the law of identity, with its excessive emphasis upon the absolute independence of things, is a result of a mental-social evolution, reflecting today the sense of individuality that is absent in primitive mentality as Lévy-Bruhl finds it, then we may well suppose that a future generation may again find justification for the belief in the unity and interconnectedness of nature.

Our sharp dichotomies of nature and human nature, organism and environment, and the like, reflect the cultural heritage of Aristotelian logic. The present theory might therefore be described as a non-Aristotelian theory of evolution. As we have already seen, Kurt Lewin has argued that one of the characteristics of what he terms the "Aristotelian mode of thinking" is its tendency to explain in terms of the individual nature of the thing itself. Appropriate to this mode of explanation is the famous problem of "heredity" versus "environment." In place of this Lewin recommends the "Galilean way of thinking," which no longer seeks the "cause" of events in the nature of single, isolated objects, but looks to fields and surroundings. In dealing with this we have argued that it would be better in the long run to adopt a

general non-Aristotelian mode of thinking that includes and goes far beyond the Galilean period and mode of Lewin.

In connection with the present theory this point is sufficiently important to deserve repetition, and we therefore pause for a moment to consider the matter in more detail.

The Aristotelian mode of thinking, which has dominated physics no less than the other sciences, holds that a thing is to be understood in terms of its own intrinsic nature (among living things in terms of the "entelechy") Following this general maxim, classical physical science attempted to investigate the nature of light "as such." Thus there eventually developed the problem of whether light was undulatory or corpuscular in nature. In recent times different sets of experiments seem to show that in certain situations light exhibits the properties of wave motion and in other situations simulates the properties of corpuscles. To be sure, there is no single experiment in which both sets of properties—undulatory and corpuscular—are revealed simultaneously. Now in terms of Aristotelian logic light is either the one or the other, but not both. In non-Aristotelian logic, which rejects the fallacy of the absolute individuality as it grows out of the subject-predicate (or "substance") logic, a thing is to be understood in terms of its influences and effects. But if a thing is the law of its behavior and in its behavior manifests dual properties, then light "is" both undulatory and corpuscular. At least the question of what light is "in itself" becomes meaningless, and the difficulty of understanding the "real" nature of light exists only so long as we insist upon adhering to the "laws" of traditional logic.

This situation shows us that in trying to understand the nature of light we must consider the "sink" as well as the "source" of energy. Whether light would radiate out into space if there were no sink to receive it we do not know. The same situation exists in connection with our sun-earth-organism hookup. A non-Aristotelian theory would insist upon the relativity of the identity of each member of this trinity. Our theory of evolution is non-Aristotelian in the sense that we admit that we can't understand the individual nature of the sun or its planets, and the energy transactions between them, without understanding the dynamics of the situation-as-a-whole. In a word, just as Aristotle in logic

and in natural science set the compass of human thought in general, so Darwin, using Aristotelian logic, mapped out the boundaries of evolutionary thinking in terms of an elementalistic theory. In the present theory it appears that a revision of the one is correlated with a revision of the other. An adequate theory of evolution is neither Aristotelian nor Darwinian, though in all fairness it must be admitted that it will have to be developed out of both.

VI. Mental Evolution and Extra-Sensory Perception

Returning to the main argument, we now present, as an additional implication of the present view, the thesis that evolution is not yet through with the human organism. Biologically, mentally, and socially man is still in process, and new traits yet remain to be evolved.

If it is true that the human mind is still developing, one may well wonder what the mentality of the future humanity will be like. It seems probable that such a mentality not only will be able to break up a complex phenomenon into its component parts and deal with a larger number of interdependent variables, but will be able to see these parts in the wholeness of their interacting unity. Thus this new type of understanding will display a higher rhythm of attention. This superior organization will be correlated with a better grasp of whole-part relations in nature, and the resulting intellectual synthesis and world-view will render obsolete our present "isms" and philosophies.

Our next suggested implication takes us back to the subject of extra-sensory perception. The two ideas we have put forth in the present chapter, namely, (1) that biological evolution is the expression of a much broader and deeper pattern of events, that indeed the cosmic matrix of evolution resides in the dynamics of our solar system and possibly even in our entire galaxy, and (2) that the next human development in mental evolution will consist in a new rhythm of psychic life, a superior whole-part understanding—these two ideas, we hold, are mutually dependent and in fact two different ways of viewing the same situation. The development of the new humanity, dependent as it is upon mutations, is nevertheless not a matter of "chance." The form of coming humanity is already present. The living earth is the giant embryo which, in its development, is being controlled by the sun as the pacemaker. The self-differentiating cosmos is bringing into

the world a super-mind in which there will be an inter-personal contact because the now synthesizing world-cortex is now establishing its mental field and social nerves. As we have suggested in the preceding pages, this new psychic faculty of extra-sensory perception is merely the social analogue of the inter-sensory unity within the individual mind of the unitary human cortex. The human race is the cortex of the entire living and evolving earth-organism, and as soon as the embryo reaches its maturity the world-mind will be attained.

Cosmic rays may serve as exciting causes of genic disturbances and the consequent variations, but morphological fields of force play an important role in controlling the unfolding of morphogenic possibilities. In time it will become clear that the earth's electrical and magnetic fields are somehow involved in this control. It is surprising how the methods employed by the geophysicists to study the electromagnetic fields of the earth resemble the study of human brain waves (electroencephalograms). Indeed, if the earth is a living organism, is it not to be expected that the terrestrial electromagnetic storms and variations, inside the earth and around it, are literally and in fact planetary electroencephalograms? The earth, too, has its electrical brain waves wandering over the world cortex. At least this is the implication suggested by Dr. Rice's theory of the earth as a living being, with the human race serving as the neuroblasts of the developing superhuman embryo.

If one were to venture still further into the frontier of speculation, it might be supposed that the spiral arrangements of protoplasmic structures that have been hypothecated are somehow related to the earth's electromagnetic field as this is developed by the revolving earth in its course around the sun. It might even be imagined that the common rotation of all the planets around the sun is connected with a solar-system field, and that the assumed spiral structure of the cells is a kind of molecular resonance of the planetary-solar field, which controls the form of the developing forebrain of evolution (humanity) to such an extent that the higher mental faculties are merely the expression of a conscious response to an underlying physical unity.

This idea that life was originally formed through the influence of fields of force acting on the spiral structures of protein molecules is something more than poetry, as is shown by the following con-

siderations. Pflüger, it will be remembered, argued that the living proteins of protoplasm contain a cyanogen group as part of their molecular composition. And Crile, we recall, believes that potassium (the only radioactive element present in the body) has the power to organize and orient a system. Both ideas are in harmony with our own theory of the sequence of stages through which the living system had to pass in its development. We start (cf. *Philosophy and the Concepts of Modern Science*, Chapter VII) from the fact that the chemistry of life is the chemistry of carbon compounds, add to this the fact that the fatty acids are the ancestors of the amino acids, and then note that these are in turn the main constituents entering into the composition of the proteins. In other words, an amino acid is a fatty acid in which nitrogen is incorporated, and these amino acids are then linked together to form proteins. Our suggestion, therefore, is this: *since in the proteins the main chains are coiled up like a spiral, may we not suppose that the coiled or spiral structure of protoplasmic systems (protein chains) has been caused by the twist given the chain structures by light from the sun, as that light has been polarized and rotated under the influence of terrestrial magnetism?* The twisting action on protein structures by polarized light and the earth's magnetic field can eventually be traced to the rotation of the earth on its axis, or the revolution of the earth around the sun, or both. Quite probably the co-operation of specific enzymes (as Max Bergmann has noted), plus the power of potassium compounds to help orient molecular patterns (nitrogen or cyanogen groups), is essential. Such a view is entirely consistent with the work of Stanley and others on the simpler proteins as the bridge between the living and the non-living.

Thus, in our theory, radiation played a role in the genesis of life here on earth, cosmic rays play a role in the subsequent evolution of those living forms, and the sun and cosmic rays and the earth's magnetic field are still functionally active in initiating the mutations that are the origin of new species. At least one authority, Dr. Harlan T. Stetson, has stated (in a letter to the writer) that this idea that cosmic rays and changes in the ionosphere may alter the course of evolution is entirely reasonable. Dr. Stetson adds that changes in the ionosphere and in the electrical potentials in the lower air follow certain cosmic cycles and might possibly be a considerable factor in organic adaptation and survival. All this

leads us to a variety of "cosmecology" that might well be interpreted as a kind of "resonance" between evolving man and the cosmos. It also lends support to our theory of the "religion of light."

VII. The New Humanity

We have spoken of the new humanity that is still to be evolved. Interestingly enough, our hypothesis throws some light upon the probable time of inception of the new era that will appear, since our hypothesis provides us with a kind of yardstick for measuring the tempo of evolutionary advance. This yardstick of evolution indicates that humanity is still in its infancy and, if nothing disturbs the rate of change, we shall have to wait a long time before what Korzybski calls the "manhood of humanity" will be attained. That is to say, the "psychozoic" age constitutes but a small sector of the Cenozoic era, which itself is relatively young. Apparently man must remain content for a long time to come before he can expect any radically new changes: *unless, through radio-eugenics, we take the fate of biological evolution into our own hands*, and in that case we may find it feasible to create or remake human nature to suit the requirements of our social engineers.

The distinguished physiologist, E. D. Adrian, has said that man's social progress has reached the point where he needs a larger brain to guide him in an increasingly complex world. If this view is correct, the induction of mutations and their selective utilization may offer our one true hope for a genuinely creative control of conscious evolution. The production of such a superior biological stock will culminate in the non-Aristotelian mentality that may better grasp the organismic (non-elementalistic) structure of nature. But how can evolution be artificially speeded up? Since at the present time man does not know how to control the ionsphere and elevate and depress it to suit his will, the increase in the number of cosmic-ray collisions with the genetic units to produce the radical mutations necessary to the creation of a race of supermen can come only through the rearing of a race of humans on the highest mountain tops where cosmic rays and showers are relatively numerous and plentiful. Of course it is possible that man will eventually learn how to produce in his scientific laboratories the wonders of heaven, and in that case his cosmic rays can be "made to order." Man's strategy has always been to "learn

from nature"—and then go nature one better. The responsibility for humanizing and spiritualizing science which this puts upon the modern alchemist is terrific, and it is this momentous problem that concerns us in the next and final chapter of this book.

Addendum

By way of criticism of our theory concerning the role of radiation in evolution, Mr. Waldemar Kaempffert, science editor of *The New York Times*, points out that all species do not evolve at the same time and at the same rate, or even in the same place. The fact that some species have remained stable for countless centuries seems to him to militate against the view that cosmic rays are a major factor in bringing about evolution.

In commenting on this criticism, let me state first of all that I hold that cosmic rays are by no means the only factor in evolution. This difficulty can also be met by recognizing that evolution seems to grow most rapidly at the "tips." Moreover, man has been highly variable as a species (as compared with the social insects) because he is far more complex than the simple organism and he varies more because there are more ways in which he *can* vary. Finally, we admit (and indeed emphasize) that in our view we—like Dr. Rice—regard the entire system of animate nature, the web of life, as a living whole, which must be treated as such. "Cosmecology" is only the beginning in understanding the interrelatedness of the developing (but not equally developing) parts of the giant embryo that planetism and global thinking try to envisage.

CHAPTER TWENTY-TWO

THE NEW ALCHEMY

Line in nature is not found;
Unit and universe are round.
In vain produced, all rays return;
Evil will bless and ice will burn.

—EMERSON

I. CULTURAL ALCHEMY

Many different figures of speech have been employed to describe the modern world. Among these one of the most appropriate is found in the statement which describes contemporary culture as a mosaic, formed by many precious stones and worthless imitations, assembled from many different places and times. A better analogy—since civilization is not the static thing that a mosaic suggests—compares the modern world to a mighty river, formed by the confluence of many cultural tributaries and streams of thought, except that a stream has in its onward movement a general direction, the parallel to which is difficult to find in the turmoil, eddying currents, and backwash of modern society.

Like the objects viewed under a microscope, modern society apparently grows more and more complex the closer we study it. Any of the seemingly unitary elements that the contemporary historian enumerates as causal agents helping to produce the world we live in may be exhibited as quite complex if we but refine our means of observation. In the field of religion this is especially true of Christianity, which is all too frequently, and mistakenly, treated as though it were a simple and readily comprehended phenomenon. At least this is true of the layman's conception. The usual (orthodox) conception of Christianity and the Bible is that they are a gift to humanity, handed out as a kind of Christmas present, ready-made for man's guidance. The doctrines approved by the Church are supposed by adherents of the various religious sects to be restatements of, or excerpts from, Holy Scripture.

And since it is supposed that the Bible is true from cover to cover, it is therefore concluded by these sectarians that they may accept the pronouncements of official theology as reliable, if not infallible, truth. It is commonly believed that Christianity, not being a product of social evolution, is free from the contaminating elements that attach to all other human processes and products. Believing as they do that Christianity has not trafficked with social influences, most devotees of the various denominations naturally suppose that their religious faith possesses eternal finality and completeness.

This, if not so true as a statement of present attitudes, is at least a fair statement of the conditions prevailing a generation ago—a condition that may conceivably be reinstated if such movements as are sponsored by the followers of Aquinas, Calvin, Barth, and Brunner gain in strength. At the moment, however, it must be admitted that the above orthodox view has been outgrown and replaced. And that fact suggests the interesting question of why it is that the attitude of the more enlightened and well-informed citizens of the modern world has changed on this matter. What are the forces, the newly discovered facts, which have compelled a revision of our ideas in this field? We may sum up our knowledge in this field in the very briefest form in the statement that historical research shows us that the Christian religion and the theological doctrines progressively enunciated by the various denominational councils give us the very best proof that religion itself is a product of evolution. Any impartial seeker after truth will find that religions, like organisms, are products of development, and as such are influenced by cultural and physical environmental factors. To prove this we need but glance at the formative period in the history of the Christian religion, the era in Roman civilization when the tenets of Christian doctrine were in process of crystallization.

Into the crucible of ancient Roman culture were poured the tinctures of many beliefs: Greek mystery cults, neo-Platonic metaphysics, Stoical philosophy, Oriental magic, and other doctrines. Out of this fusion came Christianity, a syncretistic religion so complex and so instinct with potentialities as to be all things to all men. Only the overpowering and projected influence of a single personality, Jesus Christ, prevented this patchwork of diverse doctrines from falling into pieces.

This, then, illustrates the complexities of what are sometimes supposed to be the simple factors making up the modern world. And now we ask, If present-day culture is such a heterogeneous conglomeration of elements more or less at war with each other, how can we hope to find in it any principle of cohesion? How derive a sense of cultural continuity from an aggregate itself apparently lacking in continuity and meaning? Obviously if such a principle exists, it must run through the history of human thought like an Ariadne's thread. If we are to find an idea that will provide us with a principle of synthesis comparable to what the Church offered in the Middle Ages, we must seek for a many-sided concept capable of versatile development, having its roots in cultural history and its fruits in modern science.

Throughout the entire realm of intellectual history only one idea can be found possessing the essential psychic motivation, the hereditary cultural prerequisites, and the scientific affiliations necessary to serve the race at its present juncture. This is the idea of alchemy, which today has its psychological implications as well as its chemical applications. That we should look to chemistry for cultural guidance is quite in keeping with the spirit of the times and the nobility of the discipline. No science has had such a protracted period of development, and yet is still youthful and active; no science makes so many contacts with so many different fields; no science has given birth to so many practical applications and so many fantastic absurdities.

In the recent past chemists have been the most modest and timid of proselytizers. But things are changing. The chemists today realize that they are the creators of the future; they now see that in their hands to a large extent rests the fate of the human race. Modern chemists, like the prophets of old, are forecasting coming events. They already foresee some of the services they are to render. Thus far they have stressed only the material benefits of their science. They tell us that the time is not far off when they will be "inbreeding" and "crossbreeding" molecules to produce new and more complicated chemical species, much as the artificial breeder produces new varieties of plants and animals. Recently an able chemist stated humanity's three major problems of the future—the supply of energy, the supply of food, and the prevention and cure of disease—and predicted that the chemist will play a leading role in the solution of these problems.

Unfortunately from this list one of the main problems is omitted—that of the control of human nature through the chemistry of the body. As yet we know little about the possibilities in this direction. But even this addition does not give us an adequate preview of chemistry's possibilities. The greatest of the problems that the future must face is that of the humanization and spiritualization of chemistry itself. To the solution of this problem very few chemists have addressed themselves. They might argue that this is not their problem; but with that view we are here not in sympathy. And how is this spiritualization to be achieved? This is indeed a difficult question to answer. But if we are to make any progress at all in that direction, it is surely evident that the present-day methods of expounding this science in "polysyllabic jargon" must be abandoned. If chemistry is to mean anything as a humanizing force in society, we must approach it from the cultural viewpoint as the progressive realization by man of a desire for knowledge and mastery of nature, as a spiritual quest for sublimation and refinement of nature. This last interpretation of the function of chemistry may seem strange and impractical, but that this is verily the true mission of chemistry is what we shall now, in our final chapter, seek to establish.

II. Metals and Men

In order to lend respectability and credibility to the revival of alchemistic doctrines that we here undertake, we must first state the justification for disinterring what some may regard as one of the fossils of the human mind.

The modern rehabilitation of the alchemistic doctrine dates back to the discovery that uranium and radium are undergoing a process of disintegration in which the final end-product is lead, while one of the by-products is helium. Here we are at once brought face to face with the startling fact that nature is actually producing a transmutation of elements. The attempts at artificially imitating this spontaneous process have not been altogether successful. Sir William Ramsey, in 1913, claimed to have converted hydrogen into helium, but this claim was not substantiated. It was revived later on by Dr. F. Paneth, who thought he had converted one gas into another, but here again the claim had to be abandoned. Sir Ernest Rutherford attempted a transmuta-

tion by bombarding nitrogen with alpha particles, but his original claims have not been accepted. More recently, and using different methods, the Japanese experimenter Nagoaka, and the German A. Miethe, thought they had realized the dreams of the alchemist of converting mercury into gold. These claims were later disproved. But eventually the artificial transmutation will be attained, if it has not been attained already.

These revivals of an ancient, more recently rather dubious, but never entirely discredited idea call to our attention the fact that many beliefs die hard. Some concepts seem to possess the secret of eternal youth. Notions current centuries ago among peoples whose views are supposed to represent nothing more important than the pseudo-science of magic and superstition sometimes secure a new lease on life as a result of modern scientific discovery. And so it is with the visions of the old alchemists.

It must be that some of the legends and dreams of our myth-loving ancestors possess some kernel of value which is capable of serving as the seed for the rebirth of those ideas. Freudian psychology tells us that myths are the dreams of the race. If so, we must grant that some peoples of ages past possessed an uncanny sense to dream realistically. The dream of the alchemists has been like that fabulous bird of mythology, the Phoenix, which tradition says lived in the Arabian desert, and was said to rise rejuvenescent from its ashes after having offered itself as a sacrificial victim on a funeral pyre. For this reason the Phoenix was taken as the emblem of immortality. And for the same reason we can regard the myth of the "philosopher's stone" as the Phoenix of the human mind, representing an immortal quest for some magic substance or formula that would enable the physician to cure the ills of metals and men.

When the claims of the modern alchemists are finally substantiated, one aspect, the material phase, of the alchemist's dream will have come true. But there is also a therapeutic side to alchemy, and it yet remains for science to discover the magic essence that will give to man the kind of transformation and immortality which at least some of the alchemists sought. That this phase of alchemy, the belief in and search for an *elixir vitae*, also possesses some likelihood of realization, is one of the points we shall try to establish in the present chapter.

III. Magic and Scientific Orthodoxy

In centuries past the method sometimes employed by religion in dealing with heresy and departure from official orthodoxy was burning at the stake. But science too has its faith, its creeds, perhaps also its gods. Up to the present the most that science has achieved by way of discouraging heresy and infidelity to established orthodoxy is ridicule and silent contempt. Like religion, however, science is sometimes forced to revise its pronouncements and accept as valid ideas that were formerly banished from scientific court. Much to the credit of science, this admission of error and revision of doctrine usually comes from within the domain of science itself. Several examples of this open-mindedness can be found in modern thought, but the one example with which we are concerned is to be found in the claims of the alchemists.

In the old days science, religion, and art were closely associated; in fact, they did not exist as separate interests. Perhaps the modern discovery of the philosopher's stone will provide us with the binding thread, which was drawn so tight in medieval times as almost to strangle science, but which in modern times is so slack as to permit religion to be unscientific and science to be irreligious. This lack of a binding thread between the spiritual and the material has made it possible for the power that knowledge yields to become a scourge rather than a blessing to mankind. It would therefore be a welcome consummation were science, religion, art, and poetry to unite once more, the principle of synthesis being afforded by that subtle essence of the alchemists which exalted the spirit within all things. However, as Aristotle taught us, all things should have a beginning, a middle, and an end. I therefore ask the reader to accompany me back to the beginning, which is first of all the study of the obscure origins and subterranean windings of the ancient, if not always honorable, art of the spagyrics.

IV. The Metallurgy of Gold

The origin of the science of alchemy is a matter for conjecture. In the same way, and perhaps for the same reason, the origin of the term "alchemy" is disputed. The term may have descended from the Arabic *Al Chema*, meaning the Hidden Science. On the other

hand, the term may have come from the Greek word meaning "pouring." All that we can say with assurance is that the beginning of alchemy must be sought for back in the mists and twilight of early culture. One can almost say that alchemistic doctrines are found at all times and among all peoples.

The fact that we cannot say with certainty whether alchemistic ideas were present among the Greek speculators prior to Aristotle does not mean that the birth of the idea is posterior to early Greek civilization. The idea of the transmutation of elements is much older than the Greeks. One writer states that the idea and practice of alchemy did not appear in the West until six centuries after it had been practiced in China, and that it entered Europe from the Orient by way of Byzantium and Alexandria. Another theory has it that God revealed the secrets of alchemy to Aaron and Moses. Some of the old alchemists asserted that Adam was the first alchemist. Recently an author of a book on Hindu chemistry asserted that alchemy was practiced by the old Hindus. The Arabians are also asserted to have been alchemists. And so the stories go. The reader may make his choice from among the numerous possibilities that are offered.[1]

The most widely accepted view is that the doctrine of alchemy, like other of our cultural heritages, was cradled in Egypt. It is known that the Egyptians were experts in the practical applications of chemical art, though they made no great contributions to a theoretical understanding of chemical processes.[2] The theory of the Egyptian origin of alchemy is usually associated with the old belief that the art was revealed to Hermes Trismegistus. To Thrice-Great Hermes, the god of wisdom, is ascribed the hermetic axiom, "As above so below," which the alchemists used as the basis for their analogies between the material and the spiritual. Whether such a person as Hermes ever existed we do not know. The alchemists asserted that he lived at the time of Moses, but he may be a mythical character. In any case someone must have written the many works ascribed to him. The famous "Smaragdine Table," a Latin version of which was presented in the eleventh century by the alchemist Hortulanus, was attributed to

[1] Popular accounts of alchemy are to be found in H. Stanley Redgrove's *Alchemy, Ancient and Modern*, M. M. Pattison Muir's *The Story of Alchemy*, and John Read's *Prelude to Chemistry*.

[2] A statement of the methods and results of metal-working in ancient Egypt is given in Sir W. M. F. Petrie's *The Metals of Egypt*.

Hermes. This essay, whether spurious or genuine, is one of the oldest hermetic-alchemistic writings, and like the others which followed it is sufficiently obscure to justify the statement that alchemy was an esoteric doctrine and art.

According to one legend, the secrets of this art were revealed to Hermes by the fallen angels. Here, perhaps for the first time, we come across the view that certain persons have secured a secret knowledge and power because they are in league with the forces of darkness. The doctrine of alchemy flourished for more than a thousand years and was not abandoned until the beginning of the nineteenth century. During the most of that period alchemy was associated with the belief in black magic. These centuries preceding the birth of the science of chemistry, which dates back no further than the days of Lavoisier (1743–1794), are replete with necromancy, black arts, divination, magic, and astrology. The legend that certain persons had sold their souls to the devil in exchange for knowledge and power to be used in evil ways in this world is a variant of the old theme. It will be remembered that in the Middle Ages this belief was widespread and forms the dramatic motif of the Faust legend which Goethe later employed so effectively. Indeed, Roger Bacon, that great forerunner of Francis Bacon, was thrown into prison because of his interest in alchemy and the "magical arts." Medieval scholars, such as Thomas Aquinas, admitted the possibility of transmutation, but the Church for the most part disapproved of alchemistic practices. In the *Inferno* Dante places the alchemists well toward the bottommost pit of hell, not because they were charlatans, but because by their impious arts they presumed to ape the prerogatives of the Creator.

But we must not underestimate the Greek sources of alchemy. The alchemists were mystics, students of the philosophy of the Greeks and Arabs. The idea that there is something in nature that can transmute the baser metals (containing no gold) into the noble metal, gold, assumes that all substances of nature can be derived from some primordial element. According to this theory, things differ because of the different modifications imposed upon this primordial substance. Now where did the alchemists derive this notion? Such a view, it is obvious, has some of the earmarks of an evolutionary theory, and we shall probably not be very far from the truth if we look to Greek (pre-Socratic) evolutionary

philosophy for the fundamental notions of alchemy. To be sure, we find this conception of a primordial substance in the ether (*Âkasa*) of Hindu philosophy, but no one has yet shown beyond all possibility of doubt that Occidental culture borrowed from Oriental thought.

The Greek doctrine of four elements adapted itself nicely to the needs and development of alchemistic theories. This view, first formulated by Empedocles, asserts that the fundamental elements out of which all else is made are earth, air, fire, and water. This view is accepted by Plato and adopted by Aristotle. To these elements Aristotle added a fifth, which he regarded as an ethereal substance. Aristotle held that the chief qualities of the elements are those apparent to the sense of touch: warm, cold, dry, and moist. Each of the traditional four elements was held to possess two of these fundamental properties, air being warm and moist, water cold and moist, earth cold and dry, and fire dry and warm.

It is definitely admitted in Aristotle's view that a transmutation of elements is possible. And it is not at all surprising that the Aristotelian doctrine which was later used to justify the Christian doctrine of transubstantiation should also be used by the medieval followers of the peripatetic philosophy in rationalizing the alchemistic doctrine of transmutation. According to Aristotle, an element can most readily be changed into one with which it has one quality in common, as hot fire into hot air, or cold earth into water.

As we have already noted, Greek philosophy was taken over by the Romans, who themselves made few contributions to theoretical learning. After the breakdown of the Roman empire, and during that interim which is usually called the Dark Ages, the pursuit of the philosopher's stone became the quest to which eager students of this sacred and profane art dedicated their lives. By this time the doctrine had developed that the metals are composed of two elementary *principles*—sulphur and mercury. To these was later added a third elementary principle, salt. This salt-sulphur-mercury doctrine was not supposed to be inconsistent with the acceptance of the original Aristotelian doctrine of the four elements. According to Basil Valentine, the three principles, or *tria prima*, were produced from the four elements by the interaction of these elements.

We must remember that the terms "sulphur," "mercury,"

and "salt" did not refer to the individual substances which are now designated by these names. Just what the alchemists did mean by these terms is not at all clear; they were not rigorously defined, and their ambiguities were the source of endless confusion even among the alchemists. They are, however, generally regarded as properties of bodies rather than substances. Thus salt was sometimes regarded as a principle of fixation or solidification. Paracelsus (1493–1541) for example, who founded the school of Iatro-chemistry, or medical chemistry, regarded illness as a result of a lack of balance in the body between the three great principles, sulphur, mercury and salt, and treated patients accordingly. Since he considered sulphur to be the fiery principle, fever was regarded as being due to an excess of this principle. But Robert Boyle, who founded the Royal Society in 1645 and almost founded the science of chemistry, in his classic, *The Sceptical Chymist*, inveighs as much against these three principles of the "vulgar spagyrics" as against the four "elements" of the old "hermetick philosophers."

Probably the introduction of these three elements made the confusion worse confounded, so far at least as what we may term empirical chemistry was concerned. But if we admit that in addition to this pursuit of practical ends there existed what we may call transcendental chemistry, the doctrine of three principles might be interpreted to stand for body, soul, and spirit.

V. Mysticism and Symbolism

In order to accept this suggestion as a rational explanation of the three principles, it is necessary to reinterpret the aim and method of alchemy. Empirical alchemy then is transformed into mystical alchemy. All the hocus-pocus of the art becomes an allegory, or even a device deliberately adopted to mislead the uninitiated. This view of the secret purpose of the sacred art has been presented by several students of the subject. Those who hold this view will readily grant that it has been clearly established that many of the alchemists did in fact seek to transmute base metals into gold. It is also admitted that these experimenters, sensitive to the material rewards of the successful termination of their researches, realized that gold would be of little value unless the lives of the men who possessed the secrets of alchemy were prolonged so that they might enjoy to the full the fruits of

their labors. Therefore undoubtedly many also sought the *elixir vitae*, which would grant to the possessor thereof eternal youth. Undoubtedly, too, many of these would-be chemists deluded themselves and others into believing that they had succeeded in accomplishing both desiderata. Paracelsus must have belonged to this group who looked upon alchemy as an empirical rather than a transcendental science. Thus he comments on the alchemists:

> They are not given to idleness, nor go in proud habit, or plush and velvet garments, often showing their rings on their fingers, or wearing swords with silver hilts by their sides; but diligently follow their labors, sweating whole days and nights by their furnaces. They do not spend their time abroad for recreation, but take delight in their laboratories. They put their fingers among coals, into clay and filth, not into gold rings. They are sooty and black, like smiths and miners, and do not pride themselves upon clean and beautiful faces.

But to admit this as a true portrayal of the alchemist's studies is not to deny the validity of a spiritual or esoteric interpretation of alchemy. The alchemists were "analogy-loving souls," and they, like all mystics who see in nature a double language, interpreted all visible things in terms of an occult symbolism. The real goal was not the transmutation of metals, but the regeneration of man's spiritual nature. This mystical-symbolical interpretation of alchemy is developed and defended by Dr. Herbert Silberer in his scholarly work on *Problems of Mysticism and Its Symbolism* (1917). According to this psychoanalyst, the true initiates covered their real spiritual quest under seeming chemical procedure. This misled the ignorant, which was what was desired. Medieval mystical movements, including Rosicrucianism, were concerned with the old story of the origin of life, and the problems of birth, death, and rebirth. This view that alchemy was a spiritual art rather than a metallurgy of physical elements has also been presented by Arthur Edward Waite in his study *The Secret Tradition of Alchemy*. According to this view the mastery of alchemical doctrine gives the initiate a kind of self-knowledge that enables him to transmute his inner being, purify himself, and achieve union with the Divine.

This spiritual quest for a new birth could easily degenerate into an empirical doctrine. The allegory of death followed by resur-

rection could very readily be taken literally as a statement of the stages through which a material substance must pass before it can be "purified." Hence we find the empirical alchemists becoming literalists. Metals and minerals, like man, are imperfect—they change, grow, and develop toward perfection. Since the perfect metal is gold, all other metals are trying to become gold. The alchemists therefore are merely helping nature to complete her task. It is quite in keeping with this outlook that one of the alchemists of the seventeenth century should declare:

> Copper is like a man; it has a soul and a body . . . the soul is the most subtile part . . . . The body is the ponderable material, terrestrial thing . . . . It is necessary to deprive matter of its qualities in order to draw out its soul.

Those who accept the mystical account of alchemy as the true interpretation find the best answer to those critics who condemn alchemy as obscurantism in the reply of Subtle, the alchemist, to Surly, the skeptic, in Ben Jonson's play *The Alchemist*:

> Was not all the knowledge
> Of the Egyptians writ in mystic symbols?
> Speak not the Scriptures oft in parables?
> Are not the choicest fables of the poets,
> That were the fountains and the first springs of wisdom,
> Wrapp'd in perplexed allegories?

Among those who are to be reckoned as spiritual alchemists there is one who exemplifies most excellently this viewpoint. Jacob Boehme, a Teutonic mystic of the seventeenth century (who incidentally exercised an influence in the formation of Sir Isaac Newton's ideas), may be taken as an illustration of this conception. He presents his views in *Aurora*, *The Signature of All Things*, and other writings. The thesis of *Aurora* is that gold and silver cannot be made "pure and fine" unless they are "melted seven times in the fire." He tells us that "if the fire is too hot in the fifth or sixth meltings then the new life, which hath generated itself in the rising up of the light's power out of the water, is kindled again in the fierceness of the wrath fire, the mineral ore becomes burnt scum and dross, and the alchemist hath dirt instead of gold."

I quote this passage not because I can elucidate its cryptic meaning, but because we find in such phrases as "the rising up of the light's power" an illustration of the inclination on the part of the alchemists to ascribe to light an occult power and essence. It is also evident that we may, if we wish, read into the "seven meltings of the fire" some symbolical meaning. We might inject some sense into Boehme's otherwise hopelessly obscure phrases by interpreting the "meltings" as processes of refining the forces which the theosophists supposed were resident in the body. This would be in harmony with Boehme's notion of the philosopher's stone as exemplified in the statement that the gift of alchemy is the gift of supernatural life, and that the precious stone—*Lapis Philosophorum*—which the Magi found is the spirit of Christ. In his preface to the *Signatura Rerum* Boehme tells us: "For we must know that the sons of Hermes, who have commenced in the high school of true magic and theosophy, have always spoken their hidden wisdom in mystery; and have so couched it under shadows and figures, parables and similes, that none can understand their obscure yet clear writings but those who have had admittance into the same school, and have tasted of the Feast of Pentecost."

VI. The Philosopher's Stone

There are many and diverse accounts of the nature of the elixir of life: some held it to be like sea water; others some sort of wine. By many others it was held to be liquid gold. Curiously enough, it was also supposed by some alchemists that mineral gold in the earth had imprisoned the sun's rays, and that the sun was the source of life. This recognition of the potency of light in the creation and regeneration of life is a surprisingly good guess, and forms one of the connecting links between the old and the new alchemy. This is one of the reasons for attempting to distill out the valuable elements in traditional alchemy and apply them in a modern setting. The justification for considering light as the philosopher's stone of modern science will be stated later, though we have already, here and there, dropped hints to this effect. For the moment we merely point out that although today the chemistry of life is the chemistry of carbon compounds, it is a significant fact that the organic compounds which form the physical basis of life are optically active. In general, we have

argued that the secrets of life and of consciousness lie wrapped up in such phenomena as involve the interaction of radiation (including light) and matter. The phenomena of optical activity, bioluminescence, photocatalysis, and similar processes are illustrations of this intimate interdependence. To be sure, the relations between these various biochemical reactions are not yet unraveled, but there is some underlying unity of plan that we may some day understand. The attempt to discover such a scheme is what will constitute the problem of the new alchemy.

VII. The New Alchemy

Today we are once again alchemists. And strange to behold, we find that the bridge between the old and the new alchemy is light. Once more we are gifted with the knowledge and the power of light. Therefore the future of alchemy is the future of light and light bearers. As the symbol of this reunion of the alchemy of yesterday with the creative chemistry of today, we may fittingly choose that star of the fallen angels, in Latin known as Lucifer, but in the original Greek as the Light-Bearer. These obscure utterances we now elucidate.

Why do we take phosphorus as the tie between the old and the new alchemy? Because phosphorus was to a certain extent the culmination of medieval alchemy and the beginning of modern chemistry. It seems to be established that phosphorus was first discovered by Brand, a Hamburg alchemist, in 1669. He was searching for the philosopher's stone, hoping to be able to transmute silver into gold. In the process he isolated phosphorus. Its power of glowing in the dark made it one of the wonders of nature, and it was viewed with much curiosity by the multitudes. The power to emit radiations, we now know, is not confined to phosphorus. The term "phosphorescence," however, is now applied to the process in any substance which is shining by its own light.

The explanation of the power to emit this pale light is still to be sought. Phosphorescence is usually due to the slow oxidation of some fatlike substance in the presence of moisture. And yet this oxidation is not combustion in the ordinary sense, for very little heat is given off by those plants and animals which possess the secret of producing "cold" light. The production of cold light is but one illustration of the remarkable relation between

organic processes and radiation. Another such living alchemy is illustrated by the process of photosynthesis, which enables the plant to take up through its roots the inorganic chemicals and water from the earth and transmute them into the juices of the grape—a process hardly less remarkable than the changing of water into wine, a miracle recorded in the New Testament. Here, indeed, is another alchemy by light.

If we are willing to venture a little further beyond the frontiers of science into the uncharted hinterlands of speculation, we shall be favorably disposed toward the theory that in light we have the real philosopher's stone and the elixir of life. This duality of purpose is entirely in keeping with the tradition that the quest of the alchemists was twofold: to discover the secret of the transmutation of the base metals into gold and to find the *elixir vitae*. That the modern chemist is actually on the point of realizing the dreams of the ancient alchemists is the contention of Dr. F. Paneth:

> Thus we see that in a certain sense radium possesses the first and principal property ascribed to the Philosopher's stone: it has the power of transmuting elements, although not of producing gold. And, oddly enough, even in respect to the second property which is ascribed to the Philosopher's stone radium seems to have got something from its fabulous predecessor: it is a very valuable aid in the treatment of some severe diseases, although not a perfect remedy for every illness. So that to a certain degree the radium rays really produce the two very different effects of the Philosopher's stone, transmutation and healing.

It is barely possible that this transmutation of elements, which occurs spontaneously in nature in radioactive transformations, is also occurring in the laboratory of the human body. Certainly chemical reactions of a synthetic sort do occur in the living organism. Why, then, should we not regard the living body as the alembic of the old alchemists? Do we not put into the body the various chemical elements and compounds necessary to life? Not only are water and non-metallic substances necessary to produce the material basis for personality; in addition, as we are now rapidly learning, various metals must be put into the crucible of life, eventually to be refined into the more subtle essence of spirituality. To the four main elements in the body, carbon, oxygen, nitrogen, and hydrogen, which are present in the three main types of food we eat—namely, fats, carbohydrates, and the

proteins—must be added phosphorus and calcium, no less than sulphur, which serves some function not yet fully understood. Iron is one of the metals that are essential, since it plays an important role in the manufacture of the red coloring matter of the animal's blood. Other metals essential in the life processes are potassium and copper, the latter once being regarded as poisonous though now known to be necessary. (The value of the liver treatment in pernicious anemia is supposed to be due to the presence of a minute quantity of copper in liver tissue.) It is also believed that such elements as silicon, aluminum, zinc, and others are necessary.

The role the metals play in the chemistry of the human body is still uncertain. It has been suggested that some of them are essential to make the enzymes, or even to construct the genetic units which are the bearers of hereditary biological traits. In any case we are certain that they aid in the organic alchemy of the human body, in the process whereby the living crucible transmutes the crude ores we take in as food into the nobler stuff of the human soul. Just how synthetic reactions of a creative sort take place in nature's living laboratory is not known, but that radiations of various sorts play an important part in the interaction of life and consciousness and these organic compounds of the body is an idea the writer has been advocating for many years.

On another occasion we developed the parallels between the view here advocated and the ideas of Goethe, especially as he presented them in his book, *Zur Farbenlehre*.[3] In certain respects Goethe's view resembles the old doctrine advanced by some of the ancient Greek philosophers who imagined that the process of seeing was due to bodies being touched by "feelers" sent out from the eye. Aristotle disagreed with this view, and assumed that light proceeded from the body seen to the eye through an ethereal medium. He asked the question, If the eye sends out feelers, as a lantern emits light, then why is it that we cannot see at night? But Goethe's view marks a return to the doctrine which Aristotle rejected, that in sight something issues from the eye. Indeed, Goethe quotes with approval the old Ionian maxim that like is known only to like.

Goethe's view that a light from within must meet the light from

[3] Eng. trans., London, 1840.

without in order that seeing may take place is stated in these words in the Introduction: "The eye may be said to owe its existence to the light, which calls forth, as it were, a sense akin to itself; the eye, in short, is formed with reference to the light, to be fit for the action of light,—the light it contains corresponding to the light without." This view appeared fantastic to most of Goethe's contemporaries (especially since it contradicted Newton's theory of light), and yet there is evidence that the human organism is by no means passive in the act of seeing. In addition to the evidence already suggested—that in vision radiation plays a role in the cortical response—we may also refer to the work of Frank Allen. Professor Allen argues that the way the eye sees color is more complicated than previous investigation has led us to believe. The organism is not passive with respect to the stimulus, but exercises a control over what the eyes shall see through two mechanisms, quite independent of the sensory nerve from the retina to the brain. Through this means there can be brought about a decrease of the sensitivity of the eye to some colors and an increase of sensitivity of the retina to some other color. And we might add that this control cannot be entirely "physical," as is indicated by the fact that one's "mental set" or psychical state apparently is quite active in the production of visual and color illusions.

Whatever our final theory about "visionaries" and eidetic imagery may be, our main contention, that modern science is coming around to the view that light (radiation) is the alchemist's stone brought down to date, still stands. We have already noted the interesting fact that many of the old alchemists regarded light as a mysterious essence filled with occult powers. It is no coincidence that old Balthazar, the stubborn alchemist in Balzac's masterpiece *The Quest of the Absolute*, finds in light a peculiar quintessence that will enable him to conquer the secrets of man and metals. Nor is it an anthropological accident that primitive man should bow in sun worship. He realized in some degree what science makes manifest in even fuller measure, and that is our complete dependence upon this central powerhouse and pivot of the solar system. This dependence upon radiation, visible and invisible, is becoming more evident with the passage of the years.

To try to rehearse all this evidence would be to rewrite our entire argument. Obviously that is impossible here. Let us merely

note in passing that our own thesis that our sun-planet-organism hookup has received some additional confirmation in the speculations of the late Lord Rutherford, who directs attention to the fact that science has at last succeeded in creating radioactive elements artificially by bombarding them with atomic "bullets" which transform ordinary substances (such as salt) into radiumlike elements emitting powerful radiations. Lord Rutherford calls attention also to the fact that the conditions existing in the sun are even more favorable to the transformation of ordinary stable elements into radioactive elements and then suggests that the earth, as an offspring of its sun-mother, also in its early infancy was probably in a similar condition, so that the radiant energy emanating from the then-existing radioactive elements (of which uranium and thorium are now the sole survivors) created a condition favorable to the origin and growth of living substances.

This theory is somewhat different from our own, but is not in contradiction to it and may in fact be regarded as supplementary to it, in the sense that it deals with the conditions prior to the specific synthesis and subsequent evolution of the optically active compounds previously referred to. And of course in the higher forms not only have we also supposed that cosmic rays act in providing the chromosomal mutations and consequent evolutionary spurts of new species, but in addition we have imagined that the cosmic rays are still bringing about biological processes. We have mentioned the fact that potassium is a valuable ingredient in the biochemistry of the human body. It is known that the potassium of the body is radioactive. It is estimated that there are about 40 grams of this element present, and computations indicate that about 80,000 atoms of potassium in the human body are decomposing every second and discharging electrons. The Dutch physiologist Zwardemaker suggested that this may be the energy which sensitizes the synaptic junctures (between neurones in the cortex) and thus in a measure determines the direction and flow of nervous energy. If, now, cosmic rays *are* concerned, not only in the chemistry of the body and in evolutionary development, but also in the fabrication of consciousness and the facilitation of those electrochemical reactions that are known to provide the physiological basis for mental action, then indeed nature has contrived a subtle alchemy for life processes. And thus we again return to the notion of the sun as a kind of pacemaker for evolution.

And thus the evidence accumulates that electromagnetic disturbances on and in the sun mirror themselves here on earth in disturbances of the weather, in our radio sets, in the potentials of the earth's atmosphere and electromagnetic field, and in other still more subtle ways that we are only now coming to understand. Well may Michael I. Pupin exclaim in his book *The New Reformation* that light and color are the divine message that calls man to the altar of the almighty God!

IX. The Future of Light Bearers

As we look back over the myths of the human race, we discover that the legends and dreams of mankind frequently possess a certain similarity of theme and plot, and this undoubtedly points to some underlying unity of psychic motivation. We have discussed the motivation of the dreams of the alchemists. Another theme, closely related to the tradition of alchemy, is found in the several myths concerning the intimate association between knowledge and the appearance of evil and suffering. In the tradition of alchemy this belief appears in the suspicion that the alchemists possessed a forbidden or secret knowledge, a knowledge not accessible to the uninitiated, for the attainment of which the Initiates had paid a high price.

Such a linkage of knowledge and evil can be found in a number of the world's legends. Whether we consider the "tree of knowledge" of the Old Testament, with its forbidden fruit, or the legend of Prometheus, we see that knowledge is supposed to come to man through suffering. In considering this matter one can hardly escape noting the similarity between the role Prometheus plays in Greek folklore and that which Lucifer plays in Christian mythology. In Milton's *Paradise Lost* "Lucifer" is the name given to Satan before the fall. But Lucifer, like the morning star that he is, is a light-giver. Thus we find that in many cases the spirits who pass on to the human race the torch of understanding have invited the "wrath fire" of the gods. Snatching the fire from the jealous gods, the fallen angels have transmitted to man a spark of immortality, for from this stolen flame man ignites his candles to light him on his way through the cosmic wilderness. It is through imitating deity that man himself becomes more godlike.

The old alchemists had lighted their torches from this fire, which was kindled by man with the aid of a rebel angel. These

searchers were aflame with the passion to master the secrets of nature; they desired earnestly more of the light of understanding. They were the lineal descendants of the ancient medicine men of primitive magic and the ancestors of modern men of science. Some of these inheritors of the ancient wisdom were charlatans; but the true alchemists, the *illuminati*, were a sect of spiritual seers who had kindled their fires upon a "peak of Darien," and in the smoke of the ignited embers beheld the appearance of a coming flame which was to dissipate the darkness of spiritual ignorance. In the fumes of their chemicals they envisaged the process of spiritual refinement and purification that would transmute the crude ore of biological nature into the nobler products of a sublimated self.

If we are correct in interpreting the universality and persistence of alchemistic doctrines as a manifestation of a psychic compulsion in human nature, if there is in man this deep need for mystical sublimation, then we may interpret the ills of present-day society as having their origin in part in the thwarting of the process of energic sublimation. In his Introduction to Professor Silberer's work, already referred to, Dr. Smith Ely Jelliffe states that mysticism, as an expression of the sublimation of human activity, represents the spiritual striving of mankind toward perfection. Furthermore, this psychiatrist states, the human race would go mad without this sublimation. In connection with this mystical tendency to see in nature a divine language, we may recall the words of Thomas Carlyle: "It is in and through symbols that man, consciously or unconsciously, lives, works, and has his being: those ages, moreover, are counted the noblest which can best recognize symbolical worth, and prize it highest." And does not our own Emerson give voice to the same doctrine? Let him speak for himself: "I cannot say accurately what is the analogon of each cosmical or chemical law; Swedenborg, or a possible Swedenborg, can; but I affirm with perfect security that such an analogon for each material law observed exists in spiritual nature. . . . The laws below are the sisters of the laws above." Thus speak the true sons of Hermes.

And so today we profit by the dreams of those visionaries who saw deep analogies between the material and the spiritual, between metals and men. The synthetic chemist of the modern world is the disciple of the medieval magician. Science is magic. But

will the magic of modern science prove itself to be white magic or black magic? Will it, like the transcendental art of alchemy, degenerate into the tool of mercenary empirics? Or will it live up to the best tradition of the Hermetic science? The answer to these all-important questions rests with those who impart the intellectual insight and the power of learning to coming generations. With the passage of the years it is becoming more and more evident, in a literal no less than a metaphorical sense, that the future of the world is inseparably bound up with the future of light bearers.

Humanity, like Faust, is consumed with an insatiable desire for experience. To satisfy this Faustian craving, the human race has apparently set out to sound all the depths and shoals of the cosmic environment. It is a wonderful and a fearful quest. In moments of circumspection we peer into the future, lighted up but a short distance ahead, and fading into the black night of an unknown and terrifying obscurity. In such moments one shudders and recalls the fate of Icarus, who struggled toward the light—only to plunge to an ignoble end. But when we look back over the long and arduous path we have already traveled, we see in the distance the promontories that man has already surmounted, and courage returns. Perhaps in the new day a more glorified humanity will have mastered the magic of the Hermetic art and turned it into a white magic of life and light.

X. Conclusion

In the foregoing pages we have observed that myths are the dreams of the race. We have also noted—what the Freudian theorists have long realized—that humanity lives in its dreams. To be happy, people must be aware of a purpose in life; they must feel that they are going somewhere—toward the attainment of their dreams, the realization of their myths. But the old myths are exploded, and the time has come to create a new myth. This new myth, a new dream for the human race, we think of in terms of a coming world culture and a new mode of thinking.

This new mentality we have designated as *global thinking*. Its aim is the creation of a *world sensorium*. The religion of the new humanism is based on *planetism*. It is based on a non-elementalistic or non-Aristotelian logic, and looks upon the body of our earth-organism as the environment within which the human

race—the neuroblast of the living embryo—is evolving. Thus the evolution of new species is a kind of phyletic recapitulation occurring within the emerging world mind of the giant embryo.

In our own version of the coming world religion, we have sought to show that religion is a transmutation of a form of response in lower animals known as heliotropism, and that on the side of biological evolution, culminating on the mental and cultural level in the emergence of the religious consciousness, there is evidence of a movement toward a realization of vision. That is, starting with an unconscious desire to see (due—as we have explained in our previous volume—to the invagination of the outer skin to form the neural tube, which then grows outward from the brain through the optic cups toward the external world), the life energy is eventually sublimated into the spiritual craving which is the soul's quest for illumination. In psychoanalytic terms, religious phenomena are expressions of symbolic energy concretizations, the emergent outcome on the human cultural level of the evolution of life as it has been regulated by the sun-planet-organism relationship. To understand and control this evolving system of life as it takes place within its wider cosmic environment, which acts as the pacemaker of evolution here on earth, is the new challege to the non-Aristotelian mentality.

In the application of these new ideas in social theory, interesting analogies between geometry and ethics are suggested. As we have already noted, in the flat universe of Euclid parallel lines go off to infinity; they never meet, and they never return to their points of origin. But, as we have also observed, in the spherical universe of Einstein all lines return. In the expanding universe of relativity theory the lines of the universe are not straight in Euclid's sense—they are curvilinear. Now just as geometry, or earth measurements, and astronomy, or star measurements, have been compelled to adjust their ideas to the notion of curvature, so humanity in its social orientations must realize that the earth is round. We must begin to think in spherical terms in our international relations, not only geographically, but socially and spiritually. In astronomy the shortest distance between two points is the path of a ray of light, and on the surface of the earth the shortest distance between two points is the arc of a great circle, and both of these prolonged indefinitely will return to their points of origin. In a similar way nations and peoples

must learn that we live on a spherical earth, rather than a flat earth, in the sense that the consequences of what they do eventually return to them. Just as we have learned to substitute global thinking for planal thinking in physical science, so in our orientation in the social field similar transitions will have to be made. To bring about this reconstruction is the task and the promise of scientific humanism.

INDEX

INDEX

I

J

K

L

T